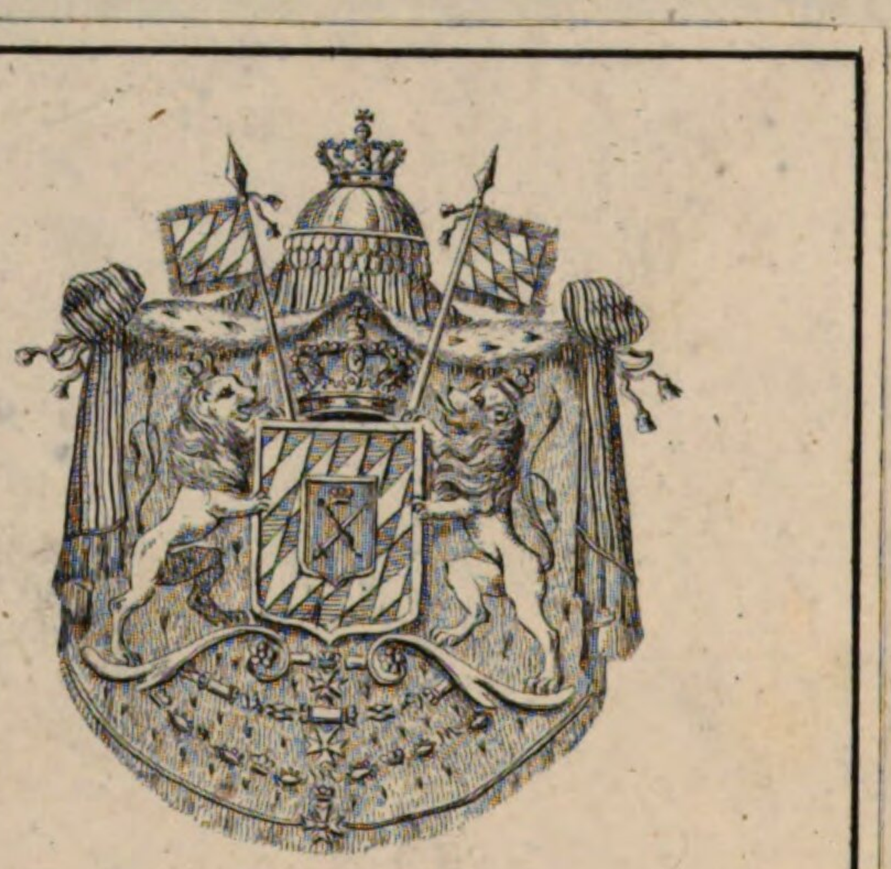
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Frontispiece.



T. Sheraton del.t *Hawkins Sculp.t*

Time alters fashions and frequently obliterates the works of art and ingenuity; but that which is founded on Geometry & real Science, will remain unalterable.

Pub.d as the Act directs Nov.r 20.th 1791. by T. Sheraton.

FRONTISPIECE EXPLAINED.

To ſhew in as pleaſing a way as I could the ſtability of this Performance, and the ſubject of the book in general, I have, by the Figure on the right hand, repreſented Geometry ſtanding on a rock, with a ſcroll of Diagrams in his hand, converſing with Perſpective, the next figure to him, who is attentive to the principles of Geometry as the ground of his art; which art is repreſented by the frame on which he reſts his hand. On the left, ſeated near the window, is an Artiſt buſy in deſigning; at whoſe right hand is the Genius of Drawing preſenting the Artiſt with various patterns. The back Figure is Architecture, meaſuring the ſhaft of a Tuſcan column, and on the back ground is the Temple of Fame, to which a knowledge of theſe Arts directly leads.

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THE

CABINET-MAKER

AND

UPHOLSTERER'S

DRAWING-BOOK.

IN THREE PARTS.

BY

THOMAS SHERATON,

CABINET-MAKER.

LONDON:

PRINTED FOR THE AUTHOR, BY T. BENSLEY;

AND SOLD BY J. MATHEWS, N° 18, STRAND; G. TERRY, N° 54, PATERNOSTER-ROW;
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HOLBORN; AND BY THE AUTHOR, N° 41, DAVIES-
STREET, GROSVENOR-SQUARE.

1793.

[Entered at Stationers Hall.]

66.

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HOLBORN; AND BY THE AUTHOR, N° 31, DAVIES-
STREET, GROSVENOR-SQUARE.

[Entered at Stationers Hall.]

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PART I.

Containing ſuch Geometrical Lines and Inſtructions as are highly uſeful to Perſons of both Branches, illuſtrated in Seven Copper-plates. To which are added the Five Orders, exhibited in five different Plates, proportioned by Modules, Minutes, and Aliquot Parts, according to the moſt approved Authority; together with ſome Account of their Antiquity and Origin.

PART II.

On Practical Perſpective, applied to the Art of repreſenting all Kinds of Furniture in different Situations; interſperſed with ſomething of the Theory, for ſuch as would know the Principles on which this uſeful Art is founded. The Whole illuſtrated in Thirteen Copper-plates.

PART III.

A Diſplay of the preſent Taſte of Houſehold Furniture; containing alſo uſeful Remarks on the manufacturing Part of difficult Pieces. To which are added, ſome Cornices drawn at large; the Method ſhewn of Gaging, Working, Contracting, and Enlarging of any Kind; together with two Methods of repreſenting a Drawing-Room.

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A.

ALLDAY John, Mahogany-merchant, Carliſle-ſtreet, Soho, London, 10 copies
Angus, Cabinet-maker, Shug-lane, London
Anderſon Henry, Cabinet-maker, ditto
Anderſon Alexander, Cabinet-maker, ditto
Archer William, Upholſterer, ditto
Allan John, Cabinet-maker, ditto
Atkinſon Thomas, Cabinet-maker, ditto
Arquart James, Profile-painter, ditto
Alliſon Robert, Cabinet-maker, ditto
Allen, Brewer, Burr-ſtreet, ditto
Appleby, Cabinet-maker, Stockton
Aſtle Thomas, Cheſter
Alderton, Cabinet-maker, Brighton
Angel Edward, Cabinet-maker
Andrews, Cabinet-maker, Ipſwich
Adams, Cabinet-maker, Strand, London
Appleton C. Cabinet-maker, Halliſax
Adams
Atkinſon William, Cabinet-maker, Rippon
Ambler, Bookſeller, Halliſax
Alderſon, Cabinet-maker, Newcaſtle
Adams, Plaſterer, Briſtol
Allen, Cabinet-maker, London
Ackermann, Painter, Ruſſel-ſtreet, London

B.

Bentham, Colonel
Barclay, Eſq. Edinburgh
Bouch William, Cabinet-maker, Wells-ſtreet, London
Beckwith, Cabinet-maker, Stockton
Bream Samuel, Cabinet-maker, Yarmouth
Burbury, Cabinet-maker, London

Blackſtock P. Cabinet-maker, Caſtle-ſtreet, Long-Acre, London
Benſley Thomas, Printer, Bolt-court, Fleet-ſtreet, ditto
Bagſter J. Cabinet-maker, Piccadilly, ditto
Bradley S. Cabinet-maker, ditto
Bails J. Bedſtead-maker, No. 434, Oxford-ſtreet, ditto
Brown Michael, Cabinet-maker, London
Bullock William, Cabinet-maker, ditto
Brunton James, Cabinet-maker, ditto
Brytam S. Cabinet-maker, ditto
Balls Thomas, Cabinet-maker, ditto
Binns Edward, Cabinet-maker, No. 1, Burden-ſtreet, Berkley-ſquare, ditto
Black John, Cabinet-maker, ditto
Bowman William, Cabinet-maker, ditto
Bales Simon, Cabinet-maker, Norwich
Blades Thomas, Upholſterer, No. 114, Jermyn-ſtreet, London
Bullock Richard, Cabinet-maker, ditto
Bowman John, Cabinet-maker, ditto
Beale John, Cabinet-maker, No. 7, Roſe-ſtreet, Soho
Beaumont Thomas, Carver, ditto
Black Algernon, Cabinet-maker, ditto
Batter, Upholſterer, Rocheſter
Bonington and Thorpe, Clock-caſe makers, No. 22, Red Lion-ſtreet, Clerkenwell, London
Black R. Cabinet-maker, ditto
Bigger William, Upholſterer, ditto
Bromridge, Cabinet-maker, George-yard, Hatton-garden, ditto
Borthwick, Briſtol
Borough, Cabinet-maker, London
Biſhop, Cabinet-maker, Houndſditch, do.
Baker, Cabinet-maker, Iſlington
Barlow, Engraver, No. 5, George-ſtreet, London
Blackland, Old Broad-ſtreet, ditto
Burnie Charles, Cabinet-maker, ditto
Bower, Cabinet-maker, No. 12, Round-court, Strand, ditto
Blacklock, Cabinet-maker and Undertaker, No. 79, Park-ſtreet, ditto
Brown James, Cabinet-maker, ditto
Belfour Alexander, Cabinet-maker, ditto
Browning John, Mahogany-merchant, No. 21, Southampton-ſtreet, Bloomſbury, London
Banks Thomas, Cabinet-maker, ditto
Bennet Ebenezer, Edinburgh
Blackburn William, Upholſterer, London
Bunnell, Upholſterer, Colcheſter
Bore, Cabinet-maker, Norwich
Barkworth John, Barton
Bryant T. Sheffield
Botcherby R. Cabinet-maker, Darlington
Bings John, Cabinet-maker, Sheffield
Beale Thomas, Cabinet-maker, York
Braidwood and Bruce, Edinburgh
Burnet and Painter, Cabinet-makers, Briſtol
Brailsford W. Cabinet-maker, Sheffield
Brailsford T. Cabinet-maker, ditto
Braſh John, Cabinet-maker, Leeds
Burn James, Cabinet-maker, Hadington
Baſſick A. Cabinet-maker, Scarborough
Benwell C. Cabinet-maker, Reading
Baſh and Reid, Bookſellers, Glaſgow
Burns, Cabinet-maker, ditto
Binns, Chair-maker, New Compton-ſtreet, London
Barclay, at the George, Monmouth-court
Benſon, Cabinet-maker, London

Barton, Lincolnſhire
Brown, Upholſterer, Newcaſtle
Bell, Painter, ditto
Bulmer, Cabinet-maker, ditto
Brummell, Cabinet-maker, ditto
Bally, Cabinet-maker and Upholſterer, No. 10, Milſom-ſtreet, Bath
Bland, Cabinet-maker, Halifax
Baiſton and Hargill, Cabinet-makers, Leeds
Beal, Cabinet-maker, London
Badger, Cabinet-maker, Batterly-moor, Lancaſhire
Boſmand
Brown, Cabinet-maker, London
Binns, Shell-maker, Smithfield, London
Brown, Lelburnel, and Co. Glaſgow
Bruce, Upholſterer, No. 307, Holborn
Bland, Gowthrop, Edmond

C.

Campbell and Son, Cabinet-makers to the Prince of Wales, Mary-le-bone-ſtreet, London
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Chriſtie R. Chair-maker, No. 2, Newman-ſtreet, London
Cliff, Upholſterer, London
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Cryſtall William, Cabinet-maker, ditto
Challis John, Upholſterer, ditto
Coats J. Cabinet-maker, ditto
Campbell A. Cabinet-maker, ditto
Chiſholme T. Cabinet-maker, No. 7, Great Pultney-ſtreet, ditto
Caſement W. Cabinet-maker, ditto
Hudſon and Corney, Cabinet-makers, No. 1, Broad-ſtreet, Soho, ditto
Cragg Leonard, Cabinet-maker, London
Cragg James, Cabinet-maker, ditto
Calvert Matthew, Upholſterer, ditto
Cleland Alex. Cabinet-maker, St. Ann's-court, Peter-ſtreet
Child, Upholſterer, ditto
Crockett Charles, Cabinet-maker, ditto
Conyer George, Cabinet-maker, ditto
Cheatham J. Cabinet-maker, Eagle-court, Clerkenwell, London
Cook J. Engraver, Mill-hill, Middleſex
Cerr J. Upholſterer, Glaſgow
Clark J. Upholſterer, London
Cowin J. Cabinet-maker, ditto
Cooper, Cabinet-maker, ditto
Cartwright, Carver, ditto
Chowles, Cabinet-maker, No. 21, North Audley-ſtreet, ditto
Crow Charles, Cabinet-maker, ditto
Cook Edward, Cabinet-maker, Cow-croſs, near Smithfield, ditto
Colborn W. Cabinet-maker, ditto
Counſel, Upholſterer, ditto
Corlett Edward, Cabinet-maker, ditto
Cook Joſeph, Cabinet-maker, ditto
Cotter W. Cabinet-maker, No. 24, Burr-ſtreet, ditto
Clark W. Cabinet-maker, Stockton
Cubitt, Cabinet-maker, London
Cooper, Cabinet-maker, Biſhopſgate-ſtreet, ditto
Croſs, Cabinet-maker, Blackfriars-road, ditto
Chriſtian Thomas, Upholſterer, ditto
Cooper Joſeph, Cabinet-maker, Derby
Cramp and Tollput, London
Carr Richard, Sheffield
Cook, Upholſterer Colcheſter

Chapman, Upholſterer, Ipſwich
Cartwright, Cabinet-maker, ditto
Chamberlain, Cabinet-maker, ditto
Caldwell, Sheffield
Cudbert John, Cabinet-maker, Whitby
Campbell John, Cabinet-maker, London
Cox Edward, Cabinet-maker, Northampton
Court, Cabinet-maker, Briſtol
Conſtantine Richard, Leeds
Crayne Thomas, Derby
Croft, Cabinet-maker, Leeds
Craſley, Workington
Craſtay, Cabinet-maker, London
Crowther, Cabinet-maker, Hallifax
Cowley, Cabinet-maker, Liverpool
Carry
Chriſtie, Cabinet-maker, London
Croſs Joſeph, Cabinet-maker, ditto
Croſs Aubery, Cabinet-maker, ditto

D.

Donald Robert, Cabinet-maker, Groſvenor-ſtreet, London
Daws Thomas, Upholſterer and Cabinet-maker, No. 27, Dean-ſtreet, Soho, ditto
Downer H. Ironmonger, Fleet-ſtreet, ditto
Dixon George, Cabinet-maker, ditto
Dales J. New-ſtreet, ditto
Dodman W. Cabinet-maker, ditto
Duncomb M. Cabinet-maker, ditto
Dent Henry, Cabinet-maker, No. 27, Little Caſtle-ſtreet, ditto
Dutton Thomas, Cabinet-maker, London
Dobſon Chriſtopher, Cabinet-maker, ditto
Digby James, Cabinet-maker, York
Daviſon W. Cabinet-maker, London
Durward, ditto
Dods James, Cabinet-maker, No. 34, Broad-ſtreet, Carnaby-market, London
Dixon, Cabinet-maker, ditto
Douglas, Chair-maker, ditto
Dick, Cabinet-maker, ditto
Duncomb Joſeph, Cabinet-maker, Great Garden-ſtreet, Whitechapel, ditto
Daniel Samuel, Cabinet-maker, ditto
Donner John, Harpſichord-maker, ditto
Doug'ld Gilchriſt, Harpſichord-maker, No. 37, Mary-le-bone-ſtreet, ditto
Dodſon, Cabinet-maker, Colcheſter
Delamain, Hull
Davies and Wilſon, Cabinet-makers, York
Donaldſon and Bruce, London
Dixwell, Cabinet-maker, ditto
Duncan James, Bookſeller, Glaſgow
Dickinſon, Whitehaven
Dobſon, Upholſterer, Newcaſtle
Dixon, Cabinet-maker, London
Dunn John, Cabinet-maker, Newcaſtle
Dillon, Cabinet-maker, Ruſſia

E.

Elcork Thomas, Eſq. Chertſey, Surry
Erſkine Francis, Eſq. Edinburgh
Elliott Charles, Upholſterer to his Majeſty, and Cabinet-maker to the Duke of York, New Bond-ſtreet
Elexander William, Cabinet-maker, Edinburgh
Engleheart P. Cabinet-maker, No. 40, Caſtle-ſtreet, Oxford-market, London
Edmonds, Upholſterer, No. 6, Compton-ſtreet, ditto
Elden Earl W. Cabinet-maker, ditto
Ellerbeck John, Cabinet-maker, ditto

England, Architect, No. 21, South-ſtreet, London
Edmundſon, Cabinet-maker, Liverpool
Edie James, Cabinet-maker, London
Eden and Son, Newcaſtle
Elwich and Robertſon, Cabinet-makers, Wakefield
Ellis Charles, Cabinet-maker, London
Elliott, Cabinet-maker, ditto
Edon, Cabinet-maker, Newcaſtle
Elliot, Cabinet-maker, London
Euſtice, Cabinet-maker, ditto
Ebditch, Cabinet-maker, ditto

F.

France, St. Martin's-lane, Cabinet-maker to his Majeſty
Fletcher, Upholſterer, No. 8, Houndſditch, London
Francis W. Upholſterer, ditto
Finlayſon James, Chair-maker, Tottenham-court Road, London
Flint Henry, Upholſterer, No. 17, Greek-ſtreet, Soho, ditto
Fairchild Rowland, Cabinet-maker, ditto
Fiſher J. Plane-maker, Great Chapel-ſtreet, Soho, ditto
Fox John, Sheffield
Femaiſter George, Upholſterer, London
Fowler Giles, Cabinet-maker, ditto
Farnes Martin, Cabinet-maker, ditto
Farlow Richard, Cabinet-maker, ditto
Finn Robert, Cabinet-maker, ditto
Furguſon Thomas, Cabinet-maker, ditto
Forreſt Robert, Upholſterer, ditto
Fairn Alex. Harpſichord-maker, ditto
Fraſer James, Cabinet-maker, ditto
Freeman, Cabinet-maker, ditto
Facey, Upholſterer, ditto
Field Joſeph, Cabinet-maker, ditto
Fleming W. Cabinet-maker, Chandois-ſtreet, ditto
Fair W. Cabinet-maker, Berwick
Fraſer John, Upholſterer, Charles-ſtreet, Mary-le-bone, London
Freeman, Cabinet-maker and Joiner, Oxford
Fletcher, Cabinet-maker, Roſe-ſtreet, Soho, London

G.

Graham, Upholſterer and Cabinet-maker, St. Paul's Church-yard, London
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Glover C. Upholſterer, Piccadilly, London
Gibbons, Upholſterer, No. 3, Goldſmith-ſtreet, Cheapſide, ditto
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Gozna John, Cabinet-maker, London
Groaters John, Cabinet-maker, ditto
Girling, Cabinet-maker, ditto
Gover John, Stringing-maker, ditto
Gibbons Joſeph, Cabinet-maker, ditto
Grant W. Cabinet-maker, ditto
Gullan David, Edinburgh
Gilney, Cabinet-maker, Caſtle-Meadows, Norwich
Goodman, Cabinet-maker, London
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Gilleſpe John, Hopton-houſe, London
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Gray J. Upholſterer, ditto
Gillies, Sheffield

Goodwin, Sheffield
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Goodill, Cabinet-maker, ditto
Gibſon, Barton
Greenfield Alexander, Cabinet-maker, Edinburgh
Gibſon Thomas, Cabinet-maker, Darlington
Gibſon James, Builder, Portland-place, London
Green T. Cabinet-maker, ditto
Grey, Cabinet-maker, Edinburgh
Gregſon, Cabinet-maker, Upholſterer, and wholeſale Feather-merchant, Preeſon's-row, Liverpool
Grimes, Cabinet-maker, Bolton, Lincolnſhire
Gibſon David, Nubegon Blebo, Fifeſhire, Scotland

H.

Houſe, London
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Halfred J. Cabinet-maker, ditto
Hodges Henry, Cabinet-maker, ditto
Harriſon William, Upholſterer, ditto
Hogg Robert, Cabinet-maker, ditto
Hill Thomas, Cabinet-maker, ditto
Higginbottom Thomas, Whiteſmith, ditto
Hill J. Upholſterer, ditto
Hughes James, Cabinet-maker, ditto
Harford J. Cabinet-maker, ditto
Hogg and Co. Chair-makers, Stephen-ſtreet, Tottenham-court Road
Hildebrant William, Cabinet-maker, ditto
Halla William, Cabinet-maker, ditto
Head William, Cabinet-maker, ditto
Henning John, Chair-maker, No. 31, Lichfield-ſtreet, ditto
Hay Thomas, Cabinet-maker, London
Hall R. Cabinet-maker, ditto
Harding J. Cabinet-maker, ditto
Hobſon G. Cabinet-maker, ditto
Harriſon William, Cabinet-maker, ditto
Hewitt John, Cabinet-maker, ditto
Horn Andrew, Cabinet-maker, ditto
Harron C. Cabinet-maker, ditto
Holt William, Cabinet-maker, ditto
Henley, Cabinet-maker, Newton-Abbot, Devonſhire
Huntſman, Chair-maker, London
Hixon Thomas, Upholſterer, ditto
Harrader, ditto
Harker Anthony, Cabinet-maker, ditto
Hannah John, Cheſter
Henderſon William, Cabinet-maker, ditto
Hughes, Upholſterer, London
Hobſon Joſeph, Sheffield
Harriſon, Cabinet-maker, Norwich
Hatch William, Cabinet-maker, ditto
Halfpenny, Upholſterer, York
Howe, Cabinet-maker, Strand, London
Hargraves, Cabinet-maker, Cloth-hall, Leeds
Haſtie, Builder, Marybone, London
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Hall John, Cabinet-maker, Stockton
Hobbard J. Stucco-worker, Briſtol
Henderſon Chriſtopher, Cabinet-maker, Newcaſtle
Hind J. Cabinet-maker, Gainſborough
Hewett and Jefferſon, Cabinet-makers, Sunderland
Haldforth Joſeph, Leeds
Hallum and Pidcock, Cabinet-makers, Nottingham
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Haſtie B. M. Cabinet-maker, ditto
Haſtew, Workington

Halbert, Carver, London
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Hays, Chair-maker, London
Howarth, Cabinet-maker, Hallifax
Hamilton, Stone-maſon, Liverpool
Hawkins, Cabinet-maker, Norwich
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Holmes, Cabinet-maker, ditto
Higgs, Cabinet-maker, ditto
Harriſon, Cabinet-maker, ditto
Houſe, Cabinet-maker, ditto

I & J.

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Johnſton, Cabinet-maker, ditto
Jilliwe, ditto
Johnſon, Malden
Jermyn, Bookſeller, Ipſwich
Iron and Son, Upholſterers, ditto
Jonſtones, Cabinet-makers, Barton
Jenkinſon John, Cabinet-maker, Sheffield
Japps, Cabinet-maker, Montroſe
Jones, Cabinet-maker, London
Johnſon, Lincolnſhire
Jones, Cabinet-maker, London
Jackſon James

K.

Kettle Henry, St. Paul's Church-yard, Lon.
King, Cabinet-maker, Chapel-ſtreet, May-fair, ditto
Kirk Thomas, Cabinet-maker, No. 8, Roſe-ſtreet, London
Kirton, J. Dealer in Muſic-paper, No. 16, Great Marlborough-ſtreet, ditto
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Kaye Robert, Cabinet-maker, ditto
King, Upholſterer, ditto
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Kendall, Leeds
Kirkwood John, Dunbar
King, Cabinet-maker, Whitehaven
Callendar Adam, Landſcape Painter, Titch-field-ſtreet, London
Knight, Cabinet-maker, ditto
Knight, Upholſterer, ditto
Kent William, Upholſterer, London-wall
Kerr, Cabinet-maker, Pall-mall, London

L

Lepard, Smith, and Lepard, Paper-manufacturers, Newgate-ſtreet, London
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Lamb William, Upholſterer, ditto
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Leatherdale, Hadleigh
Liſt, Cabinet-maker, Ipſwich
Lambert James, Coach-painter, Cliff, Lewes
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Liſle, Cabinet-maker, Newcaſtle
Levett, Cabinet-maker, Hull
Lambert, Cabinet-maker, ditto
Ledgerwood, Cabinet-maker, Greenlaw
Lunſdale, Cabinet-maker, Newcaſtle
Lyall James, Cabinet-maker, London
Lewis, Cabinet-maker

M.

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Maunder, Cabinet-maker, London
Milns, Maſter of the Commercial School, George-yard, Lombard-ſtreet, ditto
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Milner, Chatham, in Kent

Millar Joſeph, Hull

N.

Norris P. Whiteſmith, Briſtol
Newton, Engraver, Thornhaw-ſtreet, Lon.
Naſh, Cabinet-maker, Brewer-ſtreet, ditto
Newton William, Cabinet-maker, ditto
Norris J. Cabinet-maker
Noon John, Upholſterer, London
Newham R. Stockton
Nicholſon William, Joiner
Nicholſon Peter, Drawing-maſter, and Author of a Book of Lines for Joiners, Lon.
Nattes, Drawing-maſter, No. 40, South Molton-ſtreet, ditto

O.

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Oliver Robert, Cabinet-maker, ditto
Oliver, Upholſterer, ditto
Orpwood John, Cabinet-maker, ditto
Orridge John, Leeds
Odge, Cabinet-maker and Upholſterer, at Uphill, Malmſbury, Wiltſhire
Ormandy Richard, Whitehaven
Okely, Upholſterer, St. Paul's Church-yard

P.

Pringle, Wardour-ſtreet, Cabinet-maker and Upholſterer to the Duke of Clarence
Pearce, Upholſterer, Ludgate-ſtreet, London
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Penton, Braſs-founder, ditto
Prentice, Cabinet-maker, Wild-ſtreet, do.
Pettit, Cabinet-maker, Brewer-ſtreet, ditto
Pringle T. Cabinet-maker, Edinburgh
Preſsbury Philip, Cheſter
Price, Cabinet-maker, London
Potter Robert, Cabinet-maker, ditto
Price Richard, Cabinet-maker, ditto
Paul Peter, Cabinet-maker, No. 4, Silver-ſtreet, London
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Phelps Wm. Cabinet-maker, ditto
Philips, Carpenter, Mount-ſtreet, ditto
Prickett, Cabinet-maker, Foſter-lane, ditto
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Proud Wm. Cabinet-maker, ditto
Pendrill Richard, Cabinet-maker, ditto
Potts, Cabinet-maker, Compton-ſtreet, ditto
Peddieſon, Cabinet-maker, ditto
Peacock
Partridge, Cabinet-maker, ditto
Poquet, Cabinet-maker, ditto
Parker John, Sheffield
Preſton T. Cabinet-maker, Lincoln
Potter Wm. Cabinet-maker, ditto
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Pilkington, Cabinet-maker, Derby
Pointer William, Leeds
Peters George, Cabinet-maker, London
Pilkington, Upholſterer, London
Perkinſon John, Cabinet-maker, Hallifax
Potts, Whitehaven
Playſted, Upholſterer, London
Perſon Thomas, Upholſterer, Clement's-lane, Lombard-ſtreet, ditto
Park, Cabinet-maker, Hallifax
Parlby, Cabinet-maker, London
Perry, Upholſterer, ditto
Procter, Newcaſtle
Pickering, Cabinet-maker, London

Q.

Quick, Cabinet-maker, Tiverton

R.

Ramſay J. Eſq. London
Robins J. Cabinet-maker, Chancery-lane, do.
Reeder, Cabinet-maker, Oxford-ſtreet, ditto
Rawlins Philip, Turner, No. 173, Drury-lane

Rawlins, Bedſtead-manufacturer, Theobald's road, London
Rutherford, Cabinet-maker, Hull
Riſhforth, Muſical-inſtrument maker, Lon.
Randell J. Tottenham-court-road, ditto
Richards, Copperplate-printer, No. 98, Long-acre, ditto
Redford, Cabinet-maker, ditto
Robinſon George, Upholſterer, ditto
Roſs John, Cabinet-maker, ditto
Robinſon Thomas, Cabinet-maker, ditto
Robertſon Joſiah, Cabinet-maker, ditto
Robinſon Iſaac, Cabinet-maker, ditto
Robſon Thomas, Cabinet-maker, ditto
Roſs R. ditto
Raw, Great Marlborough-ſtreet, ditto
Richerley T. Cabinet-maker, Durham
Reid Peter, Grocer and Tea-dealer, Whitehaven
Rothery, Cabinet-maker, London
Rowatt, Hamilton
Riland, Cabinet-maker, Oxford-ſtreet, Lon.
Richardſon, Cabinet-maker, ditto

S.

Smirke, Painter, Charlotte-ſtreet, London
Seddons Tho. Upholſterer, Dover ſtreet, ditto
Stone, Cabinet-maker, Houndſditch, ditto
Small, Cabinet-maker, Piccadilly, ditto
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TO

CABINET-MAKERS AND UPHOLSTERERS

IN GENERAL.

GENTLEMEN,

I PRESUME, that to publiſh a Drawing-book anſwerable to the preceding title page will not require many words to convince you either of the neceſſity or propriety of the attempt.

Nor will it be requiſite to uſe an oſtentatious preface to recommend it to your notice, or to perſuade you of the utility of ſuch an undertaking. Therefore, what I have further to ſay in this Addreſs ſhall be to give ſome account of my plan, and point out to you the difference between this and other books which have been publiſhed for the aſſiſtance and uſe of Cabinet-makers and Upholſterers.

Books

Books of various deſigns in cabinet work, ornamented according to the taſte of the times in which they were publiſhed, have already appeared. But none of theſe, as far as I know, profeſs to give any inſtructions relative to the art of making perſpective drawings, or to treat of ſuch geometrical lines as ought to be known by perſons of both profeſſions, eſpecially ſuch of them as have a number of men under their directions. Nor have theſe books given accurate patterns at large for ornaments to enrich and embelliſh the various pieces of work which frequently occur in the cabinet branch. Such patterns are alſo highly neceſſary to copy from by thoſe who would ſufficiently qualify themſelves for giving a good ſketch, or regular drawing, of any thing they meet with, or are required to draw for others. It is granted that there are books of ornaments already publiſhed ſufficient for the above ends; but it may alſo be obſerved, that thoſe ornamental books which are good, are very extenſive, and of courſe very expenſive: on the other hand, thoſe that are cheap are either ſo ſmall and ill drawn, or ſo deficient through brevity, or want of examples, as to render them of little uſe to the learner. Beſides, were there no other reaſon for introducing ornaments into the following work, but the convenience of having a few good examples of this kind always at hand and ready to copy from, it would be ſufficient to juſtify the attempt. Nor indeed would this performance anſwer ſo well to the title of a Drawing-book without them. I hope, therefore,

therefore, that it will be conſidered as an enhancement to the real value and uſefulneſs of the Cabinet-maker and Upholſterer's Drawing-Book to compoſe and ſelect ſome examples of ſuch ornaments as ſhall ſerve, both for the purpoſe of the learner, and alſo to aſſiſt the ideas of thoſe who have occaſion to adorn their work in this way.

As I have alluded to ſome books of deſigns, it may be proper here juſt to ſay ſomething of them. I have ſeen one which ſeems to have been publiſhed before Chippendale's. I infer this from the antique appearance of the furniture, for there is no date to it; but the title informs us that it was compoſed by a ſociety of Cabinet-makers in London. It gives no inſtructions for drawing in any form, but we may venture to ſay, that thoſe who drew the deſigns wanted a good ſhare of teaching themſelves.

Chippendale's book ſeems to be next in order to this, but the former is without compariſon to it, either as to ſize or real merit. Chippendale's book has, it is true, given us the proportions of the Five Orders, and lines for two or three caſes, which is all it pretends to relative to rules for drawing: and, as for the deſigns themſelves, they are now wholly antiquated and laid aſide, though poſſeſſed of great merit, according to the times in which they were executed. But it may here be remarked

marked to his credit, that although he has not given rules for drawing in * perſpective himſelf, yet he was ſenſible of their importance and uſe in deſigning, and therefore he ſays in his preface: "Without ſome knowledge of the rules of perſpective, the cabinet-maker cannot make the deſigns of his work intelligible, nor ſhew, in a little compaſs, the whole conduct and effect of the piece. Theſe therefore, referring to architecture alſo, ought to be carefully ſtudied by every one who would excel in this branch, ſince they are the very ſoul and baſis of his art."

After Chippendale's work there appeared, in the year ſixty-five, a book of deſigns for chairs only, though it is called "The Cabinet-maker's real Friend and Companion," as well as the Chair-maker's. This publication profeſſes to ſhew the method of ſtriking out all kinds of bevel work, by which, as the author ſays, the moſt ignorant perſon will be immediately acquainted with what many artiſts have ſerved ſeven years to

* This is ſtrictly true of the third edition of Chippendale's book; but the firſt edition of it, printed in 1754, has given two chairs, a dreſſing table, and a book-caſe in perſpective, ſhewing the lines for drawing them. But why theſe examples were not continued in the ſucceeding editions I know not. In the laſt edition of any work, we naturally expect to ſee it in its beſt ſtate, having received its laſt reviſal from the author, or ſome other hand equal to the taſk; and therefore it can never be thought unfair for a reader to form his judgment of a book from the laſt impreſſion. I hope, therefore, this will ſufficiently apologize for the above obſervation.

know.

know. But this aſſertion both exceeds the bounds of modeſty and truth, ſince there is nothing in his directions for bevel-work, which he parades ſo much about, but what an apprentice boy may be taught by ſeven hours proper inſtructions. With reſpect to the geometrical view of the Five Orders which he has given, theſe are uſeful, and the only thing in his book which at this day is worth notice, as all his chairs are nearly as old as Chippendale's, and ſeem to be copied from them.

The ſucceeding publication to this ſeems to be Ince's and Mayhew's Book of Deſigns in Cabinet and Chair Work, with three plates, containing ſome examples of foliage ornaments, intended for the young deſigner to copy from, but which can be of no ſervice to any learner now, as they are ſuch kind of ornaments as are wholly laid aſide in the cabinet branch, according to the preſent taſte. The deſigns in cabinets and chairs are, of courſe, of the ſame caſt, and therefore have ſuffered the ſame fate: yet, in juſtice to the work, it may be ſaid to have been a book of merit in its day, though inferior to Chippendale's, which was a real original, as well as more extenſive and maſterly in its deſigns.

In looking over Ince's book I obſerved two card-tables with ſome perſpective lines, ſhewing the manner of deſigning them. Theſe, ſo far as they go, are a uſeful attempt; but cer-

tain it is to me, from ſome experience in teaching, that no perſon can have the ſmalleſt acquaintance with the principles of perſpective, merely from ſeeing two or three lines joined to a plate, without proper inſtructions by letter-preſs. It is true, a deſcription is given of theſe lines in the 7th page of his book, but not equal to what is abſolutely requiſite to ſuch as have no previous acquaintance with the art; and thoſe that have, will not require that which can give them no aſſiſtance. Properly ſpeaking then, what is done in this book, relative to perſpective lines, can only ſerve as a hint to the workman, that this art is eſſential in deſigning.

In the year 1788 was publiſhed, " The Cabinet-maker's and Upholſterer's Guide." In which are found no directions for drawing in any form, nor any pretenſions to it. The whole merit of the performance reſts on the deſigns, with a ſhort deſcription to each plate prefixed. Some of theſe deſigns are not without merit, though it is evident that the perſpective is, in ſome inſtances, erroneous. But, notwithſtanding the late date of Heppelwhite's book, if we compare ſome of the deſigns, particularly the chairs, with the neweſt taſte, we ſhall find that this work has already caught the decline, and perhaps, in a little time, will ſuddenly die in the diſorder. This inſtance may ſerve to convince us of that fate which all books of the ſame kind will ever be ſubject to. Yet it muſt be owned, that books

of

of this ſort have their uſefulneſs for a time; and, when through change of faſhions they are become obſolete, they ſerve to ſhew the taſte of former times.

I ſhall now conclude this account of books of deſigns with obſerving, that in the ſame year was given a quarto book of different pieces of furniture, with the Cabinet-maker's London Book of Prices; and, conſidering that it did not make its appearance under the title of a Book of Deſigns, but only to illuſtrate the prices, it certainly lays claim to merit, and does honour to the publiſhers. Whether they had the advantage* of ſeeing Heppelwhite's book before theirs was publiſhed I know not; but it may be obſerved, with juſtice, that their deſigns are more faſhionable and uſeful than his, in proportion to their number.

Upon the whole then, if the intended publication, which now petitions your patronage and ſupport, be ſo compiled and compoſed as fully to anſwer, and alſo to merit, the title which has been given to it, I think it will be found greatly to ſupply the defects of thoſe books now mentioned, and will appear to

* This is not meant to inſinuate any diſreſpectful idea of the abilities of thoſe who drew the deſigns in the Cabinet-maker's Book of Prices. I doubt not but they were capable of doing more than Heppelwhite has done, without the advantage of ſeeing his book: and it may be, for any thing I know, that the advantage was given on their ſide.

be on as laſting a foundation as can well be expected in a work of this kind. For inſtance, the firſt part, which provides the workman with geometrical lines, applied to various purpoſes in the cabinet branch, cannot be altered any more than reaſon itſelf. The ſame may be ſaid of Perſpective; the ſubject of the ſecond part. This art, being founded on Geometry and Optics, may be improved in its practice, but its fundamental principles can never be altered, any more than the nature of viſion and thoſe immutable principles upon which good ſenſe is founded.

With reſpect to mouldings and various ornaments, the ſubject of the third part, it is granted that theſe are of a changeable kind. Yet it is pretty evident that materials for proper ornaments are now brought to ſuch perfection as will not, in future, admit of much, if any, degree of improvement, though they may, by the ſkill and touch of the ingenious hand, be varied, *ad infinitum*, to ſuit any taſte at any time. It may be neceſſary to obſerve alſo, that this book will have the advantage of exhibiting the preſent and neweſt taſte of work; for, whilſt we are teaching the practice of Perſpective, the examples given ſhall both ſhew the neceſſary lines for deſigning, and likewiſe repreſent, in different ſituations, ſome uſeful or faſhionable piece of furniture. To this advantage we ſhall alſo add another, namely, that every example in pieces of furniture will have the geo-

metrical

metrical dimenſions laid down on the ground, or other ſcale lines adapted for that purpoſe. So that no perſon, however ignorant of Perſpective, ſhall be liable to miſtake the Perſpective for the geometrical meaſurements, or be at any loſs to know the general ſizes of ſuch pieces as ſhall be introduced*. And we may ſay, with reſpect to changes of faſhions, that he who is properly acquainted with lines, verſed in Perſpective, and ſufficiently practiſed in ornamental drawing, will, from a few hints, be able, at any time, to turn his hand to any faſhion.

Laſtly, I would entreat leave to remark, that, as the publication of this work will be attended with very great expence, the accompliſhment of my deſign will principally depend upon

* The Cabinet-maker's Book of Prices adverti ſes thoſe who are ignorant of Perſpective to take care how they apply their compaſſes to the deſigns, leſt they ſhould make any miſtake about the ſizes. But I do not ſee how this can be avoided by ſuch as are ignorant of the art, ſince there are no directions given how to apply them, nor neceſſary ſcales for the purpoſe of obtaining the true meaſurements. They have given a ſcale for the front of their deſigns, which ſerves to give the height and length of ſuch of them as are drawn geometrically in front, but can be of no ſervice in finding the width of a piece of work drawn in perſpective; becauſe its apparent breadth is much narrower than the real or geometrical one. And it may be further obſerved, that we cannot determine the height of a book-caſe merely by a ground ſcale, when the book-caſe is drawn in perſpective, becauſe then the top part recedes or falls back from the front, it is therefore in appearance lower than the real height. For which cauſe, if any perſon was to apply the compaſſes for the height of a piece of work of the above kind, they muſt be totally deceived reſpecting its height. Therefore, in the following work, every difficulty of this kind ſhall be obviated, and proper directions given how to avoid theſe errors, and to apply the compaſſes, ſo as to obtain every neceſſary dimenſion.

the encouragement I meet with from you as ſubſcribers; and I hope, on my part, that neither care nor aſſiduity will be wanting to give you all poſſible ſatisfaction, and to render the book as complete as is in the power of,

GENTLEMEN,

Your humble Servant,

THOMAS SHERATON.

INTRO-

INTRODUCTION

TO

PART THE FIRST:

CONTAINING SOME PRELIMINARY OBSERVATIONS.

GEOMETRY literally means, to meaſure the earth*, but in practice is applied to many arts and trades, as well as ſcience in general. With reſpect to that part of it which becomes uſeful to us, it is pleaſant and eaſy, readily underſtood, and of a mechanical nature; ſo that no workman need to be ſhocked or frightened at the idea of learning ſuch geometrical lines and figures as ſhall be conſidered in the ſubſequent pages. Nor is it requiſite to the workman to begin with the uſual definitions in geometry, as theſe would be foreign to my plan, and unneceſſary

* Geometry; from γη *gè*, the earth, and μετρον *metron*, to meaſure.

for

for him to know. For inſtance, he needs not be told that a point is without parts or magnitude, that a line is length without breadth, or that the terms of a line are points, &c. &c. Theſe, and a number of others of this kind, are known by the common underſtanding of every one. I ſhall therefore confine myſelf to ſuch particulars as every candid workman will at once pronounce uſeful, and which may be applied to the practice of ſome parts of the ingenious art of Cabinet-making. Yet, from what I have here advanced with reſpect to geometrical definitions, I would not be underſtood as ſpeaking diſreſpectfully of them, much leſs to deny their uſefulneſs to ſuch as learn geometry regularly. It is impoſſible to proceed without theſe, when this ancient and divine ſcience is taught as the groundwork of mathematical learning. We might as well attempt to teach logic without a method of arranging or diſtinguiſhing ideas, or arithmetic without the powers and properties of numbers, as geometry diveſted of its chain of definitions and axioms, &c. by which at length we arrive to the certain knowledge of truth, and are able to demonſtrate it to others. But, on the other hand, as it is poſſible for a man of ſound ſenſe to reaſon well without knowing the rules of logic as they are taught in fine and regular ſyſtems, ſo, I apprehend, it is alſo poſſible for a workman of no learning, but what is common, to attain to a uſeful knowledge of geometrical lines, without the trouble of going through a regular courſe of Euclid's definitions and demonſtrations,

monſtrations, &c. And we may juſtly ſay of his definitions and demonſtrations, the ſound of which ſo often alarming the ears of the ignorant, that they are, as a certain writer obſerves, " Built upon a few principles of common ſenſe, without which the moſt domeſtic and ſimple negotiations of life cannot be tranſacted, and that, what they ſhun as ſubjects too ſublime and intricate for their comprehenſion, are only the moſt familiar truths made artificial by regularity and diſguiſed by a technical language."

Upon this view of Geometry, I ſhall now proceed to the conſideration of ſuch Problems as every workman of tolerable capacity will eaſily underſtand, and find advantageous to him.

And, for the ſake of making every part of this book as intelligible and uſeful as I am able, I ſhall, in the courſe of proceeding, explain ſuch * technical terms as may be neceſſarily uſed in the ſubſequent pages, and which, for propriety's and brevity's ſake, cannot well be avoided on ſubjects of this nature. And, in attempting this, I hope not to incur the diſagreeable title of a pedant; as I pretend not to give theſe explanations as the produce of my own ſkill in Etymology, but ſhall recommend them to the reader as they are found in the writings of

* From τεχνη, *techne*, *art*; which belong to the terms and rules of arts and ſciences.

men of unqueſtionable abilities in this way*. Beſides, when it is conſidered that the following work is not written for the learned, but ſuch as may want ſome aſſiſtance in the derivation of particular words uſed in Geometry, Architecture, and Perſpective, in order to fix their real meaning more laſtingly on their memory, it is preſumed that this conſideration alone will, in the view of the candid, ſufficiently apologize for me. As for thoſe of an oppoſite caſt of mind, it is not eaſy to ſay what would pleaſe, or what diſpleaſe, them.

* As Chambers, Johnſon, Bailey, Parkhurſt, Lemon, &c.

THE
CABINET-MAKER AND UPHOLSTERER'S
DRAWING-BOOK.

PART I.

CONTAINING NECESSARY INSTRUCTIONS FOR OBTAINING THE KNOWLEDGE OF SUCH LINES AS ARE USED IN BOTH BRANCHES.

SECT. I.

On dividing a Line into any Number of equal Parts—raiſing a Perpendicular on a given Point—and the Method of dividing a Frieze or Pilaſter into Flutes and Fillets.

* PROBLEM I. PLATE I. FIG. 1.

A RIGHT line being given, to divide it into any number of equal parts. The line to be divided is 7.1, which is to be divided into 7 parts.

Operation.—Firſt, From 7, on the given line, draw a right line at pleaſure, making any angle with the line to be divided.

* Problem, προβλημα, *problema*, "from βαλλω, *ballo*, to throw, and προ, *before*, i. e. to propoſe, or ſet before: a propoſition relating to practice, or which propoſes ſomething to be done; as to biſect a line given, to draw a circle through any three points;" or, as in the preſent caſe, to divide a line into any number of equal parts.

Then with the foot of your compaſſes, fixed on 7, turn the arch * 1.8, and, without any alteration of the inſtrument, place its foot in 1, and turn the arch 7.9 at pleaſure.

Second, Take the ſpace 1.8, and place it on the arch 7.9 drawn indefinitely †. Then from 1 to 9, draw a right line, which will be parallel, to the line 7.8.

Thus far it ſhould be obſerved, that the problem teaches to draw two lines parallel, both with diſpatch and accuracy.

Laſtly, with your compaſſes, opened at random, lay on the diviſions 1, 2, 3, 4, 5, 6, on both lines, firſt from 1 to 9, then from 7 to 8, and by drawing lines from each correſpondent point, the given line 1.7 will then be divided as required.

A little reflection will point out the reaſon of this, if we conſider that the lines 7.8, 1.9, are perfectly parallel to each other.

For if the diviſions laid on each line be greater or leſs than thoſe ſought for, yet lines drawn acroſs to each reſpective diviſion will cut the line to be divided in the ſame points; becauſe

* Arch, from *arcus*, a bow, *Lat.* and, when uſed in Geometry, implies "any part of a circumference of a circle."

† That is, without bounds or limits.

what

what is loſt or gained on one line, by theſe uncertain diviſions, will be regained or loſt, when the ſame uncertain diviſions are placed the contrary way on the other parallel line. This is clearly exemplified in the figure by the ſmall dotted diviſions on each line, which are ſhorter than the proper ones on the given line. Yet, if right lines be drawn through each correſponding dot, they will cut the given line as before.

The ſmall dotted line drawn acroſs, from the correſpondent points near to 1.5, demonſtrates this, and therefore it is unneceſſary to ſay more.

Problem II. Fig. 2.

To divide a frieze or pilaſter, &c. &c. into any given number of flutes and fillets: the following method is a moſt certain and quick one.

1. Let A B be the ſuppoſed width of the pilaſter required to be fluted.

Operation.—Draw the right line C D indefinitely. Take then two pair of compaſſes, one for the flutes, and the other for the fillets; and with the firſt opening of your compaſſes for the flutes, lay it on C D, and divide this uncertain opening *a b* into three. Again, take one of theſe three parts for each fillet, as *c a*, and

repeat

repeat it on the line C D, firſt a fillet, then a flute, till you have the propoſed number, which in this caſe is 5, (and always in pilaſters ſhould be an odd number*.)

Second, Extend your compaſſes from *c* to *d*, the whole ſpace which the uncertain diviſions include; and with one foot on *c* or *d*, turn the arches E *c* and E *d*, and from the point, where theſe two arches interſect as at E, draw right lines to *c* and *d*, which will then form an equilateral triangle.

Laſtly, Draw lines from all the diviſions on C D to E the angular point. After which, take A B in the compaſſes and turn the arch *e d*, and through the two ſections *e d* draw a right line, then will *e d* be equal A B, and the pilaſter or frieze will be divided in the moſt accurate manner as required.

Problem III. Fig. 3.

To raiſe a perpendicular from any given point on a line as its baſe.

* Obſerve, any opening of one pair of compaſſes will do the whole buſineſs, if a previous calculation be made of the equal parts contained in all the flutes and fillets. Thus, in the preſent caſe, we ſay there are five flutes, allowing the ſpace of three fillets to a flute, which make together fifteen; and the addition of ſix, the number of fillets in the pillaſter, make twenty-one. Therefore lay on the compaſſes at random twenty-one times, and proceed as above.

Operation.

Operation.—Let G be the given point on the baſe line G V. Take then the * radius G O, or any other at pleaſure, and turn the arch O S. Fix again your compaſs foot in O, and, without any alteration, interſect the arch at P. On P, with the ſame opening of the compaſſes, make another ſection at S, and from thoſe points S P turn an arch each way, and their interſection will form a point perpendicular with the given point G, as required.

This may alſo be effected another way with more diſpatch, but perhaps not always with equal accuracy.

Operation.—Let ME, Fig. 14, Plate 2, be the baſe, and E the point whence you would erect a perpendicular. With any opening of the compaſſes, and with one of its legs fixed any where out of the line, as at S, ſweep the arch *b*, *d* till it cut the baſe line, as at *b*. Then from *b* draw *b s* through the center S, cutting the arch at *d*, and their ſection will form a point perpendicular to E, as required.

Theſe problems may be very uſeful to an Upholſterer when he is laying down the plan of a room for a carpet, as it is not convenient always to take a ſquare with him. Beſides, by a good line, bradaul, and chalk, a perpendicular may be raiſed

* Radius, a right line drawn from the center of a circle to its circumference. This right line, I conceive, anſwers to the rays of light (in an optical ſenſe), which, falling upon the eye every where in right-lined directions, form a horizon to our ſight.

with more exactneſs than can be drawn on a floor by a ſquare. But, as I intend giving ſome directions to the Upholſterer how to lay down a room in an accurate manner, ſo that a carpet may be properly cut by his plan, I ſhall at preſent ſay nothing more on this ſubject.

Problem IV. Fig. 4.

To draw a perpendicular line by a ſcale of equal parts, as by a common rule, or by a rod divided.

Operation.—Let the line G V be the line required to raiſe a perpendicular from. Let V be the propoſed point, and from any ſcale of equal parts lay down ten of thoſe parts from the point V towards G. Take then ſix of thoſe parts (or ſix inches of the common rule) and turn the arch 1.2 at pleaſure. Again, take ten parts, or ten inches of your rule, and place the end of the rule or rod on the eighth of thoſe ten parts or inches, and with the other hand, by a pencil, interſect the arch 1.2, by which a point will be gained exactly perpendicular to V, as required.

This problem will be of uſe to the Cabinet-maker and Upholſterer when neither ſquare or compaſſes are at hand. For inſtance, if a Cabinet-maker would cut a board acroſs perfectly ſquare, without compaſſes, chalk line, or ſquare, if he have but a rod, let him proceed thus:

Divide the rod into ten equal parts, and by this ſtraight rod ſtrike a line on the ſide of the board; then lay down ten parts on this line, and proceed as above.

SECTION II.

On the Uſe of a common Caſe of Inſtruments, together with ſome Geometrical Problems conſidered.

As the various inſtruments found in common caſes are not commonly underſtood by Cabinet-makers and Upholſterers, and as the principles by which they are deviſed and conſtructed are purely geometrical, I think it neceſſary and uſeful to give an explanation of them, ſo far as they can any way aſſiſt the above perſons, or others, in the practice of drawing.

The firſt thing that needs be noticed is a ſcale of feet and inches.

The intention and uſe of a ſcale is to reduce the real meaſurements of any object to a convenient proportion, ſo that it

may be repreſented on a ſheet of paper, &c. with as much exactneſs as if it were drawn at full ſize*.

A ſcale of feet and inches ſhould be uſed when we repreſent any piece of furniture either geometrically or perſpectively, becauſe ſuch a ſcale anſwers to our common rules; but when we lay down any figure by the help of mathematical inſtruments, then a ſcale of tenths muſt be uſed.

On the Conſtruction and Uſe of a Scale of Feet and Inches.

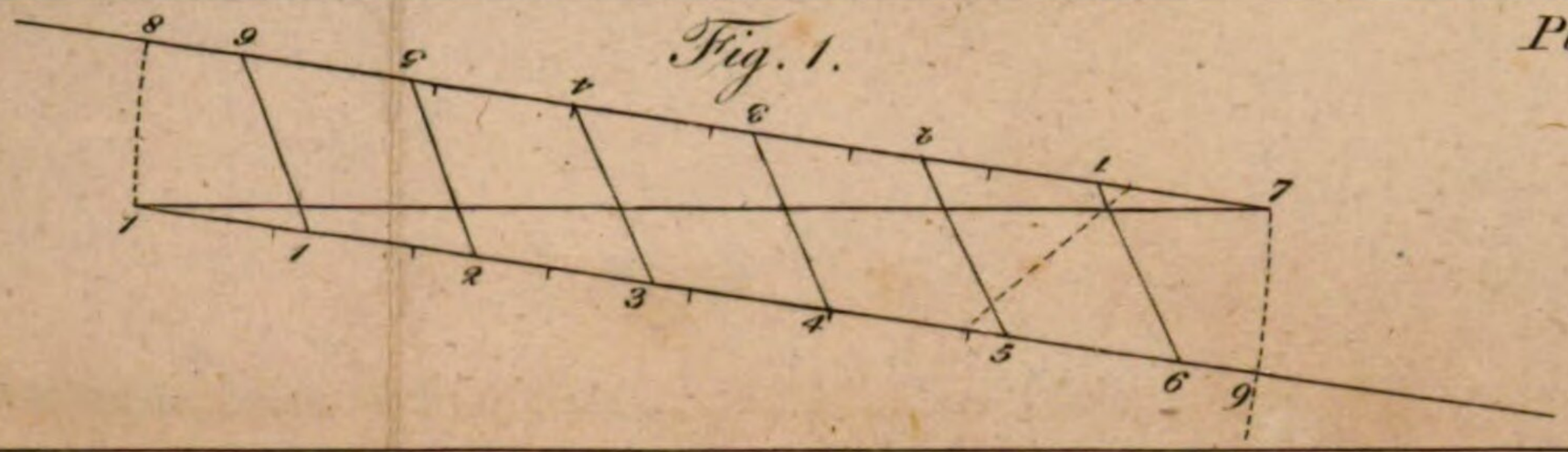
To underſtand a ſcale of feet and inches, draw ſeven lines parallel to each other, and at equal diſtances, as in Plate I. Fig. 9. Then, as on the line 1, 2, 3, lay down as many diviſions for feet as will comprehend the largeſt dimenſion of the piece you would draw. Secondly, divide one of theſe parts, which you ſuppoſe to be a foot, into twelve equal parts, the number of inches in a foot; to effect which, divide that part or foot into two equal parts, as at 6: draw then the two lines 6.1, 6.12, and the foot will be divided as required, and in the moſt ac-

* The term Scale ſeems to have been derived from the ſteel-yard, and its notches or diviſions marked on the beam, to adjuſt the different degrees of weight by.

 curate

Plate I.

Fig. 1.



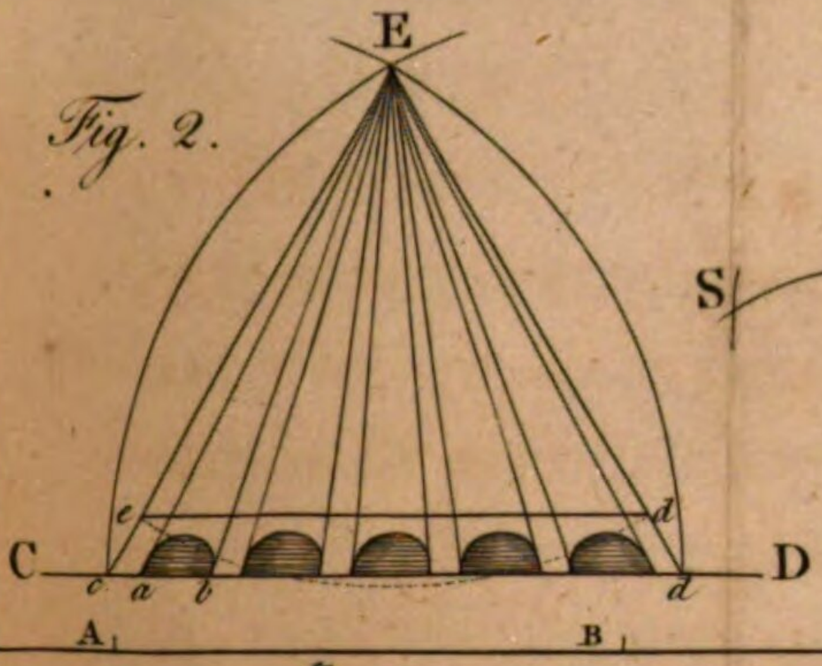


Fig. 2.

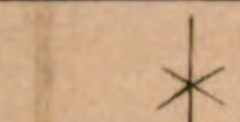


Fig. 3

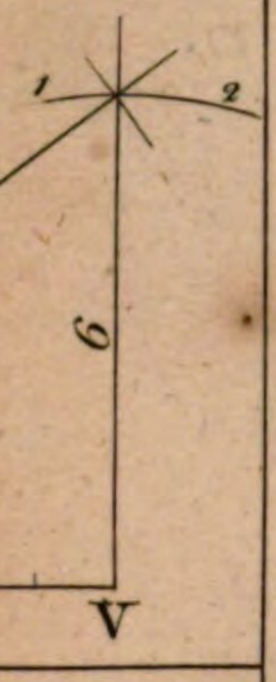


Fig. 4.

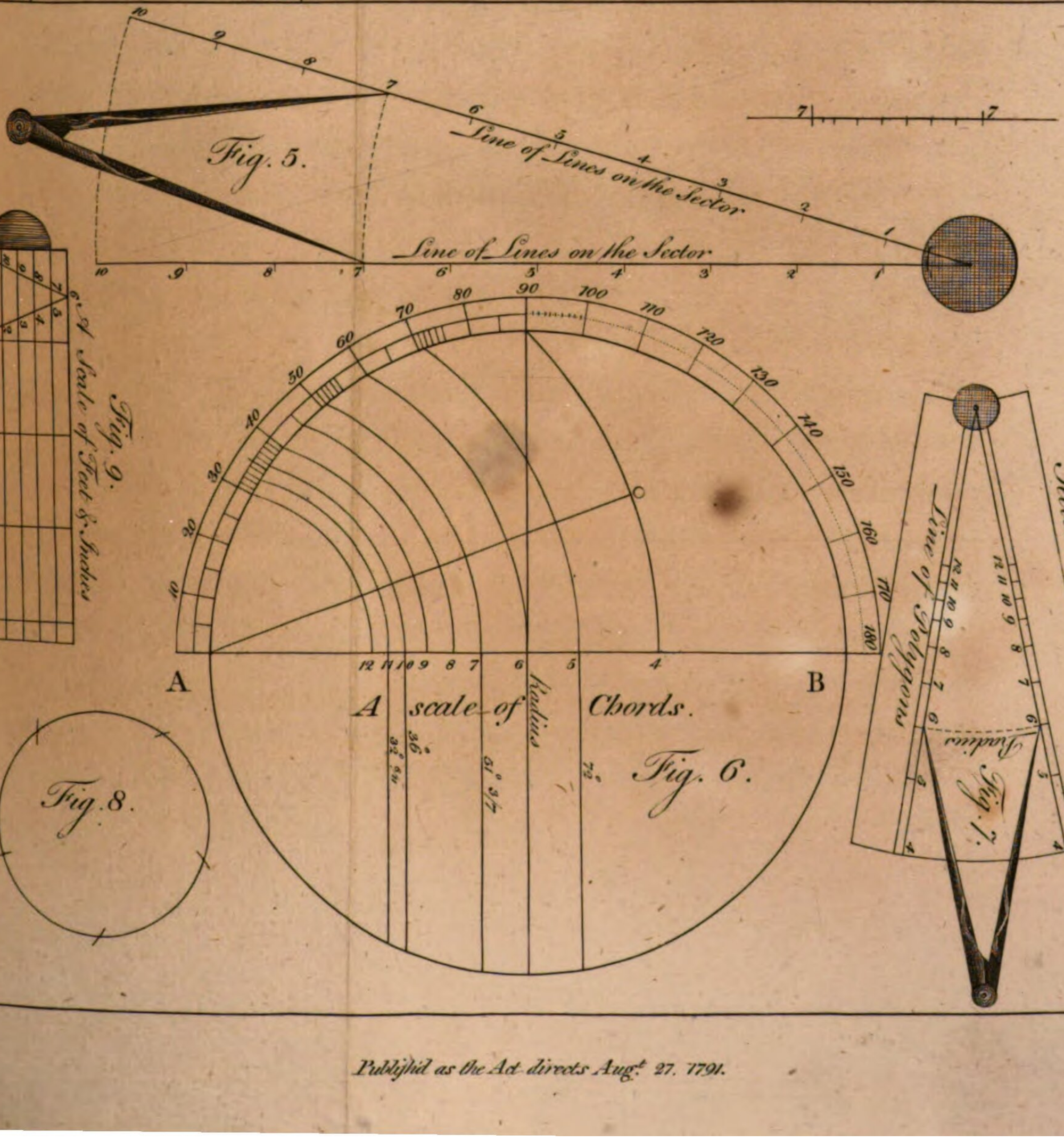


Fig. 5.

Fig. 9.

Fig. 6.

Fig. 8.

Fig. 7.

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curate manner, as is clearly demonſtrated by the ſmall diviſions on the line 12.

To uſe the Scale.

If you want one foot one inch, place your compaſs foot on the ſecond line from the bottom, over 1, and extend the other foot to No. 1 on the ſame line. Again; if you want one foot two inches, then place the foot of your compaſſes on the third line from the bottom, over 1, and extend the other foot to No. 2 on this line. Laſtly; if you want three feet ſeven inches, place one foot of your compaſſes on the ſixth line, over 3, and extend the other foot to No. 7, and ſo on for any other number of feet and inches that may be required.

On the Conſtruction and Uſe of a Scale of Tenths.

Draw eleven lines parallel to each other, and at equal diſtances, as in Fig. 10, Plate II. Afterwards lay down eleven diviſions, as you ſee on the ſcales found in caſes of inſtruments (I have divided mine only into ſix, for want of room). Take one of thoſe diviſions or parts, and by Prob. I. Fig. 1, divide it again into ten equal parts, placing the diviſions on the bottom and top line. Then from the point *o* draw a line to the point before 2 on the top line, and ſo on, as the Figure ſhews. When all theſe lines are drawn, there will then be preciſely one hundred equal

parts, diſtinguiſhable by the dots on the ſeveral angles of the rhombs, becauſe, being divided into ten each way, they multiply into one hundred, by which we ſhall be able to take any tenth or any hundredth part of the large diviſions 1, 2, 3, 4, &c.

To uſe this Scale.

If you want one of the large diviſions and one 10th, this is aſcertained by placing one foot of your compaſſes on No. 1, and extending the other to the firſt diviſion beyond *o*, and ſo on, as may be required. Again, if you want one large diviſion (which may be called a foot) and nine hundredth parts of a foot, place one foot of your compaſſes on the line 9, and extend the other to the firſt tenth on that line, and you will then have one foot and nine hundredth parts as required. Laſtly, if you want five feet five tenths of a foot and five tenths of an inch, place your compaſs foot on No. 6, on the right hand end of the ſcale, which is the ſixth line from the bottom, and extend the other foot to the ſixth dot on the ſame line, and the required dimenſion will be obtained. It will be evident therefore, by a little reflection on the nature of this ſcale, that any tenth part of a foot, and any tenth part of an inch, may be accurately taken.

The ſcale of chords comes next under conſideration. This ſcale is commonly found on the contrary ſide to that whereon

whereon the ſcale of tenths is marked, which we have now deſcribed. The uſe of it is to lay down angles of different degrees, and to divide a circle into various proportions and parts.

The Conſtruction and Uſe of a Scale of Chords.

1. Open the compaſſes to ſixty degrees on the ſcale marked CHO, Fig. 11, Plate II. and by this opening deſcribe a ſemicircle, as BDA, Fig. 12. Then if the arch BD be divided into ten equal parts, thoſe parts 10, 20, 30, &c. will anſwer to 10, 20, 30, &c. on the ſcale of chords, Fig. 11. Hence, if you want to divide a circle into twelve parts, take thirty from the ſcale of chords, and apply the compaſſes to the arch BD at 30, then BD will contain it three times, and conſequently the whole circle will contain it twelve times. If again you want this circle divided into eight equal parts, then from the ſcale take the chord of 45, and apply it to the arch BD at 45, and this will divide the quadrant into two equal parts, and therefore the whole circumference may, by the ſame opening, be divided into eighths. In this manner any other diviſion of a circle may be certainly known at once, which a little thought will eaſily make clear, and therefore it is unneceſſary to give any other example on dividing a circle into equal parts.

This

This ſcale may likewiſe be uſed in laying down any angle* not more than ninety degrees. Draw the line G *o*, Fig. 16, at pleaſure; then take the chord 60° and ſweep the arch *o o* at pleaſure. With your compaſſes take the chord 37°½ and place it on the arch *o o*; draw the right line G *o*, and you have an angle of thirty-ſeven degrees and an half, and ſo of any other, to ninety degrees.

On the PROTRACTOR†.

THE Protractor is a ſemicircle of braſs, divided into one hundred and eighty degrees, by the help of which we may deſcribe an angle of any aſſigned quantity whatever, and likewiſe meaſure any angle already laid down.

Let the arch, divided into one hundred and eighty equal parts, on the line A B, Fig. 6, Plate I. be conſidered as the braſs protractor, which is found in common caſes of inſtruments.

* Angle. "This ſeems to be from Αγκυλος, *ankulos*, the bending of the elbow;" and in Geometry, implies the point in which two lines meet: but the quantity of an angle is the ſpace comprehended between the two lines meeting in a point, as *o o*, Plate II. Fig. 16, and its proportion is expreſſed by degrees; which term, Degree, means ſimply the three hundred and ſixtieth part of a circle, whether great or ſmall.

† Protractor, from *protractum*, "to draw out in length;" accordingly, by the help of this inſtrument we may draw out the legs of a triangle to any length we pleaſe.

Firſt,

Firſt, obſerve the center of the protractor, diſtinguiſhed by a ſmall notch on the diameter, anſwerable to 6, on A B, Fig. 6.

2d. Let it be required to lay down an angle of ninety degrees, and let A B be conſidered as the baſe. Then place the ſmall notch on the diameter of the braſs protractor, upon 6, on the line A B, and make a mark exactly over 90; conſequently a line from 6, the center, to 90, the vertical* point, will form an angle of ninety degrees, or what we commonly call a ſquare.

Again, if an angle of forty-five be wanted, proceed as before, and make a dot over 45; to which draw a line from the center, and it will be an angle as required; and ſo of any other to any quantity. This is ſo plain, that to ſay more would be needleſs. It may however be proper to obſerve, that the quantity of any angle already laid down may alſo be found by the protractor as follows.

Let G *o o*, Fig. 16, Plate II. be the angle to be meaſured. Take the Radius, or half diameter of the protractor, and ſweep the arch *o o*; then open the compaſſes to *o o*, and apply them to the degrees marked on the inſtrument, and it will immediately be ſeen how many of thoſe diviſions are contained in the angle, which number of diviſions are called the quantity of the angle.

* *Vertical*, "placed in a direction perpendicular to the horizon."

On

On the SECTOR *.

The Sector is a moſt univerſal inſtrument, and uſed for various purpoſes in the different branches of mathematical learning. Nor is it without its uſefulneſs in the art of drawing, and therefore thoſe who are concerned with deſigning ought, in ſome meaſure, to be acquainted with it.

To this end let us firſt conſider the moſt ſimple part of it, which is, to divide any given right line into any number of equal parts.

The line to be divided by the ſector is 7.7, Plate I. Fig. 5, which is to be divided into ſeven.

Firſt, Look for the line of lines on the ſector, which may be found by obſerving two braſs centers marked with L on each limb of the inſtrument.

Second, Take the length of the line 7.7 in your compaſſes, and place one foot on the point 7 on the line of lines, and opening the ſector, extend it till the other leg of the compaſſes co-

* Sector; it is ſo called becauſe, when it is opened, it comprehends a portion of a circle between two ſemidiameters, making an angle at the center, as O A 4, Plate I. Fig. 6.

incides

incides with the point 7 on the other limb of the inſtrument, as Fig. 5 clearly expreſſes. In this poſition keep the ſector, and moving the compaſſes to 1.1, which is the neareſt figure to the center of the inſtrument, contract their legs till you take the opening 1.1, which, if correctly done, will be one-ſeventh part of the line 7.7, as propoſed. Perhaps it may be required to divide a line into fourteen; if ſo, then as there are only ten on the line of lines, you take half the length of the given line in your compaſſes, and place their legs on the points 7.7 as before; and, as this opening is but half the length of the line to be divided, the compaſſes muſt be contracted to 1.1 as before, and then the line will be divided into fourteen, becauſe twice ſeven is fourteen.

In this way any right line, to be divided into any number of parts, may be brought upon the ſector. To make this ſtill more plain, let it be propoſed that a line twice the length of the line 7.7 is to be divided into twenty-eight equal parts. Take the line 7.7 in your compaſſes, and proceed in all reſpects as before, except one thing, i. e. in place of contracting the legs of the compaſſes till they touch the points 1.1, you muſt draw them in till they touch the lines at half the diſtance of 1.1 from the center, as the dark line next the center of Fig. 5 ſhews. This opening of the compaſſes will turn fourteen times on the

line 7.7, consequently it will turn twenty-eight times on a line twice its length.

Of the Line of Polygons on the Sector.*

This line is intended to divide a circle into equal parts, by which any kind of Polygons, from a pentagon to a duodecagon, may be formed. Hence it is distinguished by the letters POL on this instrument.

Let it be required to divide the circle, Fig. 8, into five, which forms a Pentagon. Take the radius or half diameter of Fig. 8, and opening the sector, as described by Fig. 7, place the compass on the point 6.6, marked radius. In this position keep the sector, and, without any variation of the instrument, you may divide the circle 8 from 4 to 12. In the case before us it is into five; therefore take the compasses from the points 6, and extend them till they touch 5.5, and this opening will go five times on the circle 8, as will be evident if you take 5.5 in your compasses from Fig. 7, and apply it to Fig. 8.

Lastly, if you want the circle 8 divided into twelve, by which to form a Duodecagon (see Plate II. Fig. 26), the sector still remaining unaltered, place your compass legs on the points

* "Polygon, from πολυς, *polus*, many, and γωνια, *gonia*, a corner, having many corners or angles."

12.12, and apply them to the circle 8, and it will be divided as required.

Obſerve alſo, that a geometrical ſquare may, by the ſame means, be inſcribed in any circle; for by keeping the ſector extended as before, and opening the compaſſes till their legs touch on 4.4, this opening will turn four times on the circle 8, and therefore will form a ſquare.

How this line of Polygons is divided ſo as to proportion any circle in this manner, will eaſily be underſtood by conſidering Fig. 6.

Deſcribe a circle of any radius, and draw the diameter A, B. Divide one-half of the circumference into one hundred and eighty equal parts, called degrees, and from 90° draw the arch 4 from the center A, then will the lines A O and A 4 repreſent the limbs of the ſector, Fig. 7, and 4 on Fig. 6 will anſwer to 4 on Fig. 7.

Next draw the arch 5 from 72°, and from the center to 5 will be the chord of 72°, the degrees contained in the ſide of a Pentagon, anſwerable to 5.5 on Fig. 7.

Proceed to the arch 6, and obſerve, that this is the radius

of the circle, and is always equal to the chord line 60°, and therefore contains a length equivalent to the ſide of a Hexagon, or a ſix-ſided figure, and agrees with 6.6 on Fig. 7.

After theſe remarks, I think it unneceſſary to go through each chord line; only the reader ſhould obſerve, that I have marked ſuch chords as have fractional parts on the fine lines, or thoſe drawn perpendicularly from A, B. For inſtance, the chord for a Heptagon is fifty-one degrees and three-ſeventh parts of a degree; and the meaning of three-ſeventh parts is nothing more than to divide a degree into ſeven, and to take three of thoſe parts and add to fifty-one, which is exactly the ſide of a circle divided into ſeven, called a Heptagon. Theſe parts are eaſily found and proved by dividing three hundred and ſixty, the number of degrees contained in a whole circle, by the quantity of ſides contained in any Polygon, for then the quotient will be the number of degrees which are in the arch of every ſuch chord line.

Thus for a Heptagon; divide three hundred and ſixty by ſeven, then will the quotient be fifty-one degrees and three-ſevenths, equal to the ſide of a heptagon.

Of the Line of Chords on the Sector.

The Chords on the fixed ſcale have already been conſidered (ſee page 29). Theſe chords are limited to one circle, which, to ſuit that ſcale, muſt always be drawn by the compaſſes extended to ſixty degrees: but the ſcale of chords on the ſector is unlimited, becauſe the chords of circles of various radiuſes may be found according as the limbs of the inſtrument are more or leſs extended.

The line of Chords is on the ſame ſide of the ſector with the Polygons, marked with *c* nigh to a braſs center on each limb: and if it be required to find the chord of thirty of any circle, take the radius of the given circle, and open the ſector till the compaſs legs coincide with thoſe braſs centers at 60.60, then contracting the compaſſes till their legs touch 30.30, the required chord line will be found. In this manner proceed in any other caſe; always obſerving that the ſemi-diameter of the circle muſt limit the opening of the ſector at the braſs centers.

By this line of Chords on the Sector it is evident that a circle may be divided into ſeven hundred and twenty equal parts with conſiderable diſpatch and great accuracy.

Of the Line of Sines on the Sector.

A Sine is a right line drawn from one end of an arch perpendicularly upon the diameter drawn from the other end of that arch, as the perpendicular line 90, drawn from the diameter B A, Fig. 12, Plate II. is the ſine of the arch B D; and ſo likewiſe all the other perpendicular lines, as 1, 2, 3, 4, 5, &c. on the line B A, are ſines of ſo many different portions of the arch B D A.

The line of Sines on the ſector, which Fig. 13 is intended to repreſent, is marked *s s* nigh 90.90, with two braſs centers, one on each limb of the inſtrument. The ſeveral diviſions on this line, marked 10, 20, 30, &c. anſwer to theſe perpendicular lines 1, 2, 3, 4, 5, &c. on the line B A, Fig. 12, and the different ſituations of thoſe perpendicular lines are found by dividing the arch D A into nine equal diviſions. Perpendiculars being then drawn from each reſpective diviſion on the circumference of the circle to the diameter A B, they are of courſe denominated ſines of 10, 20, 30 degrees, and ſo on.

To draw an Oval by the Sector.

Firſt, Draw a circle that will comprehend the longeſt diameter of the oval you wiſh to deſcribe, as the circle B D A, Fig. 12. Divide the quadrant D A into nine equal parts.

Second,

Second, Take then the ſhorteſt diameter in the compaſſes, and place one foot on the ſine 90°, and open the ſector till the other coincides or touches 90° on the other limb of the inſtrument. In this poſition keep the inſtrument fixed, and contract the compaſſes till their feet touch the ſine 80°.80°; transfer this opening of the compaſſes to the perpendicular line 8 at 80, which mark with the point of a pencil.

Proceed to the ſine 70, keeping the ſector ſtill in the ſame poſition, and, after contracting the compaſſes till their legs touch 70.70 on the ſector, transfer this opening to the perpendicular line 7 at 70°, and ſo on of all the reſt to the ſine 10, by which will be obtained nine points, contracted in due proportion* from the arch D, A; and a line, paſſing through each of theſe points, and drawn by a ſteady hand, will form an ellipſis perfectly true and agreeable, as is evident by the figure.

From what has been ſaid, I preſume it will eaſily be underſtood by every one how to proceed with the other quarters to complete the whole ellipſis.

* This is evident by obſerving, that as a right line drawn from 45 on the tangent line to the center 9, cuts the arch D A in the degree 45; ſo likewiſe will a right line drawn from 10 on the tangent line to the center, cut the elliptic arch 90 A in the ſame degree.

A circle

A circle may alſo be deſcribed by the ſector upon the ſame principle that an ellipſis is drawn by it. This, in itſelf, is not very neceſſary to be known, becauſe when we have no compaſſes, no uſe can be made of the ſector, and when we have them by us, they are the beſt inſtrument for drawing a circle. However, ſince what belongs to the drawing of a circle by the ſector, partly belongs to the deſcribing of an ellipſis by this inſtrument, I ſhall venture upon this Problem.

Operation.—Draw a right line at pleaſure, of length enough to contain the diameter of the circle to be drawn. Biſect * this line, and draw a line at right angles with it of the ſame length. Take then the ſemi-diameter of the circle, and place it on the lines each way.

Open the ſector, and on the line of ſines proceed as before to take the ſine 80. Transfer this to any ſemi-diameter, as 9 A, Fig. 12, which will extend to 1 on that line. Then proceed to take the ſine 70, and transfer this alſo, which will extend to 2 on that line. Proceed to the ſine 60, and this opening will ex-

* A line is ſaid to be biſected when it is divided into two equal parts, from "*bis* and *ſectum*, to cut in two;" an operation which is eaſily performed by ſweeping two arches from the extremities of the line to be thus divided; as from *b* and *d*, in Fig. 14, where two arches interſect, which if a line be drawn from theſe interſections, it will both biſect the given line, and will at the ſame time be drawing one at right angles to it.

tend

tend to 3 on the ſame line, and ſo on, till you take the ſine 10, which will extend from 9 to 8. The ſame muſt be done on the other radius, as you take the ſines from the ſector. Having thus divided one diameter, draw perpendicular lines from each diviſion each way at random. Laſtly, take the ſame ſines again from the line 9 A, and place them upon their reſpective ſines; that is, take from 9 to 1, which is the ſine 80, and place this upon the perpendicular line 8 at 80, and ſo of all the reſt, and they will form thirty-ſix points for the whole circle; through which points, if a line be correctly drawn, the circumference of a complete circle will be produced with as much accuracy as when we draw the circumference of an oval in the ſame manner.

*Of the Tangent * Line on the Sector.*

A tangent is a right line drawn perpendicular on the extremity of ſome radius, touching the circumference of the circle, but not cutting it, as A 45, Fig. 12.

This line is of uſe to divide the circumference of a circle into any number of equal parts, and may be found on the ſector by a braſs center on each line, marked T. To this line there

* Tangent, from *tangens*, Latin, touching.

is added another of the ſame kind, marked T on each limb, but without a braſs center to it.

To divide a circle by this line, proceed thus:

Take the radius of the circle to be divided, and with this opening, place the compaſs legs on each line T, marked 45.45, then will the ſector be prepared for finding every degree of a circle up to 45. This is clear; for if the radius be laid down on the tangent line, Fig. 12, as at 45, a line drawn from 45 to 9, the center, will cut the arch D A at 45 degrees, as is obvious by inſpection. Thus the circle may be divided into eight, ſince forty-five is the half of ninety, conſequently the eighth of three hundred and ſixty. The ſector being ſtill in the ſame poſition, if you want to cut the arch D A at 10 degrees, contract the legs of the compaſſes till they coincide with 10.10 on the tangent line, and transfer this on the tangent line A 45, and a right line being drawn to the center as before, it will cut the arch D A at 10. Hence if the arch D A is required to be divided into nine, the extent of the compaſſes at thoſe ten degrees will turn nine times on the arch D A.

It has already been obſerved, that there are two tangent lines on the ſector. The tangent line which has not the braſs center, is to increaſe that which has one up to 75, as it is marked

on

on that line. When therefore any degree above forty-five is wanted, take the radius of the circle to be divided, and open the ſector till the compaſs legs touch 45 on the ſecond tangent line on each limb; then will the inſtrument be prepared for taking the tangent of any degree up to ſeventy-five, by proceeding in the ſame manner as on the firſt tangent line.

SECTION III.

On the Names and Properties of various uſeful Geometrical Figures of the Superficies.

To have ſome knowledge of the names of uſeful geometrical figures is certainly of advantage to every one, and eſpecially to ſuch perſons as are concerned with drawing or making pieces of work of the like forms.

It is certain from experience and matter of fact, that many, not acquainted with names of this kind, are obliged to uſe a dozen words and ſigns when one would be ſufficient.

Beſides, a knowledge of theſe names, together with an acquaintance with the general properties and manner of drawing ſuch figures, muſt certainly be conſidered as an introductory ſtep to a more advanced knowledge of Geometry, by thoſe young men who intend to riſe higher in this ſublime ſcience, than can be expected to be taught in a drawing-book.

I ſhall therefore begin with the names and properties, and afterwards deſcribe the conſtruction, or manner of drawing, the moſt generally uſeful figures.

Of the Superficies.* (See Plate II.)

No. 1, is a Geometrical Square, ſo called becauſe it has four ſides of equal length, and four right angles.

No. 2, is a Parallelogram. This figure receives its name from its oppoſite ſides and ends being all parallel to each other.

No. 3, a Rhomb, which is properly a geometrical ſquare moved out of its poſition, ſince all its ſides are equal, but not its angles, two of them being acute, and the other obtuſe.

* Superficies, *ſuperficies*, Lat. the ſurface or outermoſt part of any thing, and in Geometry are ſuch figures as are bounded by one or more lines, or an extenſion which has length and breadth, but no thickneſs.

No. 4, is a Rhomboides, a figure which bears the ſame affinity to a parallelogram that a rhomb does to a geometrical ſquare. A rhomboides has its ſides and ends parallel to each other, but its angles differ the ſame as thoſe of the rhomb; and therefore a rhomboides is a parallelogram moved out of its proper form.

No. 5, is a Trapezoid, which has four ſides, two of which are parallel, and two not, the ſame as the ſeats of ſome chairs.

No. 6, a Trapezium, containing four ſides, which are all unequal, and none of them parallel.

Theſe ſix figures, being all of them bounded by four right lines, are, by geometricians, called quadrangular or quadrilateral plain figures.

Of various Triangles.

No. 7, is an Equilateral Triangle, ſo called becauſe all its ſides are equal to one another; and, as every triangle contained under three equal ſides, whether circular or mixed, are called equilateral, ſo the figures 11, 12, 15, are alſo of that denomination.

No. 8, is a Right-angled Triangle, becauſe two of its ſides are perpendicular to each other, and conſequently make an angle of ninety degrees, as the line 9.90°, Fig. 12, is perpendicular to B A, therefore A 9.90° forms a right-angled triangle, comprehending a part of a circle equal to ninety degrees.

In all right-angled triangles, the ſides containing the right angle are called the Legs, as the ſides 9 A, A 45 are the legs of the triangle 9 A, 45, in Fig. 12; and the oppoſite ſide to the right angle is called the Hypothenuſe, as the line 9.45, in the triangle 9 A, 45, is the hypothenuſe ſide of that triangle.

" The perpendicular height of any triangle is a line drawn from the vertex to the baſe perpendicularly:" thus if the triangle P E O, Fig. 15, be propoſed, P O muſt be conſidered as its baſe, and conſequently E its vertex; and if from E you draw the line E P perpendicularly to P O, then the line E P is the height of the triangle E P O, ſtanding on P O, its baſe.

No. 9, is a triangle called Scalenous, becauſe none of its ſides are equal, nor its angles alike in quantity. A Scalene Triangle is compoſed of two kinds of angles, one obtuſe, and the other acute; ſo alſo a right-angled triangle is compoſed of two, a right one, and an acute.

All other triangles are of the acute kind.

An obtuſe * angle is one that is greater than ninety degrees, or more than what we call a ſquare, as a line from 9 to the point D, Fig. 12.

An acute angle is leſs than ninety degrees, as a line from 9 to 10, conſidering the ſide 9 A as their baſe.

No. 10. This triangle is called Iſoſceles, becauſe two of its ſides are equal in length, as G *o*, G *o*, Fig. 16; or if the ſector be opened, a triangle of this kind is fitly repreſented by it.

Theſe four triangles, being bounded by three right lines, are called rectilineal plain triangles; and in general, theſe are placed before the quadrilateral, or four-ſided figures, becauſe by geometricians they are conſidered as more ſimple, having only three ſides: but as triangles generally appear more out of the way to workmen, I have aſſumed this liberty to place them after four-ſided figures.

Of mixed Triangles.

Of this kind are numbers 11, 12, 13, 14, and they are called mixed triangles, becauſe ſome of their ſides are right lines, and

* Obtuſe ſignifies flat or blunt, and acute ſharp or cutting.

ſome

ſome curved ones. Three of theſe are equilateral, or equal-ſided, if meaſured by a right line; and No. 14 is a ſcalene triangle by the ſame rule, as none of its ſides are equal. The ſides of theſe mixed triangles that are round, are called convex *, but thoſe that are hollow, as No. 13, 14, are called concave.

Of Spherical † Triangles.

A ſpherical triangle is one that is curved on every ſide, as No. 15 and 16. Theſe are both of the equilateral kind, becauſe their ſides may be bounded by right lines of equal length.

Of Mixtilineal Figures.

No. 17, is of this kind; and every other figure that is bounded both by right and curved lines is called mixtilineal.

Of theſe figures ſome are regular, and ſome irregular.

When a figure of this kind is compoſed of equal curved and equal right lines, then it is called a regular compound mix-

* Convex is properly applicable only to any ſolid that has a curved or ſwelled ſurface, and concave is the contrary.

† Spherical, ſomething like a ſphere or globe.

lineal figure; but when its ſides and ends are formed of unequal curved and unequal right lines, then they are called irregular compound mixtilineal figures.

Of this ſort is No. 18.

Of Polygonal Figures.

All Figures bounded by more than four right lines are termed Polygons.

The figures included between No. 19 and 26 are all of this denomination. But each of theſe figures has its particular name from the number of the ſides of which it is compoſed.

No. 19, is therefore called a regular Pentagon *, becauſe it is bound by five right lines of equal length; but if any of thoſe lines were unequal in length, then it would be termed an irregular Pentagon. The ſame diſtinction is applicable to any other of theſe figures in ſuch caſes.

* Pentagon, from πενὲ, *pente*, five, and γονια, *gonia*, a five-cornered figure. The other Polygons have all their particular names formed in the ſame way, from the Greek numeral adjectives.

No. 20 is termed a Hexagon,	becauſe it has	6 ſides or angles.
21 a Heptagon,		7
22 an Octagon,		8
23 a Nonagon,		9
24 a Decagon,		10
25 an Undecagon,		11
26 a Duodecagon,		12

No. 27, is a figure ſo well known that it is unneceſſary to ſay any thing about it.

The ſame may be ſaid of the Semi and Quadrant, Nos. 28 and 29, the one being an half, and the other one-fourth of a complete circle.

No. 30, is called the Greater Segment * of a circle, becauſe it is the greateſt part of a circle cut in two by a right line; and of courſe No. 31 is the Leſſer † Segment, becauſe it is not equal to a ſemi. But if we ſpeak of a ſegment without regard to compariſon, it is a figure contained between a chord and an arch of a circle.

* Segment, from *ſegmentum*, a piece cut off.

† Leſſer. This way of forming the comparative adjective is by Dr. Johnſon and Lowth conſidered as barbarous; but as cuſtom has ſo long prevailed in the uſe of it, and as the ear ſeems to prefer leſſer rather than leſs, I thought it would ſuit the readers beſt to retain it.

No.

No. 32, is an Ellipſis *, commonly called an oval. This figure may be conſidered, in one view, as produced by the ſection of a cone, by a plane cutting both ſides of the cone obliquely to its baſe. In this caſe the ellipſis produced muſt be irregular, ſince a cone is a ſolid which terminates to a point at the top; and therefore any ſection oblique to its baſe muſt produce an oval broader at one end than the other. To demonſtrate this, nothing more is requiſite than to get a piece of wood turned in the ſhape of a ſugar-loaf, and let it be ſawn acroſs in a ſloping direction from the bottom of it, and the ſurface of the cut will be an irregular oval. But if a cylinder be cut oblique to its baſe, there will then be produced an Ellipſis perfectly regular, and alike at each end.

It may alſo be obſerved both of a circle and an oval, that they are the only regular ſuperficies that are bounded by one line; and thoſe which are bounded by two, are their reſpective ſegments: as Figures 28, 30, 31, 33, 34.

No. 33, is the Semi-ellipſis, or Half-oval; and it is ſaid to be on the tranſverſe diameter, when the right ſide is equal to the

* Ellipſis, from ελλειψις, *ellipſis*, a defect or omiſſion. If a ſuperfice be apparently round, but, on meaſuring it, if one of its diameters be found ſhorter than the other, there is then a defect, and we ſay that the figure is elliptic.

longeſt diameter; but when it is only equal to the ſhorteſt diameter, then it is ſaid to be on the conjugate, as No. 34.

No. 35, is termed an Hyperbolic Figure. When a cone, Fig. 12, Plate IV. has a ſection parallel to its axis, the curved boundary produced by the ſection is an Hyperbolic Figure; and when its ſection is parallel to the ſides of the cone, then the curved boundary produced is called a Parabolic Figure.

SECT. IV.

Of the Manner of drawing various uſeful Geometrical Problems.

In the preceding ſection, the names and ſome of the properties of the moſt generally uſeful ſuperficies have been conſidered; and I ſhall now deſcribe the method of drawing them. However, in doing this it will not be neceſſary to deſcribe every particular figure, ſince the ſame operation for one will ſometimes apply to various others.

PROB. V. FIG. 14.

To draw a Geometrical Square.

By the ſecond method of Prob. III. raiſe a perpendicular, as E *d*, Fig. 14, Plate II. then extend the compaſſes equal to the ſide of the propoſed ſquare.

Fix one foot in E, and ſweep the arch *b d*, which will cut the line E *b*, E *d*, equal to the ſides of its ſquare. Laſtly, from *d* and *b*, with the ſame opening of the compaſſes, ſweep the other arches, and their ſection will form a perpendicular to the points *b* and *d*, by which the ſquare is completed.

From what has been ſaid, it will eaſily be underſtood how to draw a Parallelogram.

PROB. VI. FIG. 2 and 16.

To draw a Rhomb.

If the ſides of this figure be intended to incline at an angle of ſixty degrees, all that is neceſſary is to draw two equilateral triangles from their oppoſite baſes: and to draw an equilateral triangle is nothing more than to take in the compaſſes the given

ſide

ſide of the triangle, and from a right line turn an arch each way, as Fig. 2, Plate I. and their ſection, as at E, by lines drawn to it, completes the figure.

Then if a right line be drawn parallel to C D at E, and *c d* be laid on this line, ſuppoſed to be drawn, it will complete the Rhomb.

But if a Rhomb be required to be drawn, whoſe oblique ſides are wanted to be inclined thirty-ſeven degrees and a half, take the radius of the protractor and from the center G ſweep an arch, as *o o*, Fig. 16. Draw G *o*, and take from the protractor thirty-ſeven degrees and a half, and lay it from *o* to *o*. Let the right line G *o* be the given ſide of the Rhomb; and how the other ſides are to be drawn, reaſon itſelf will dictate.

The Rhomboides, being of the ſame ſpecies of figure, is eaſily drawn by the ſame rule. Nor is it requiſite to deſcribe the method of drawing any other of the figures till we come to the Pentagon, becauſe ſome of them are variable, and thoſe that are not ſo, are drawn by the ſame rules that are applicable to the Square, Rhomb, and Equilateral Triangle.

PROB.

Scale of Tenths

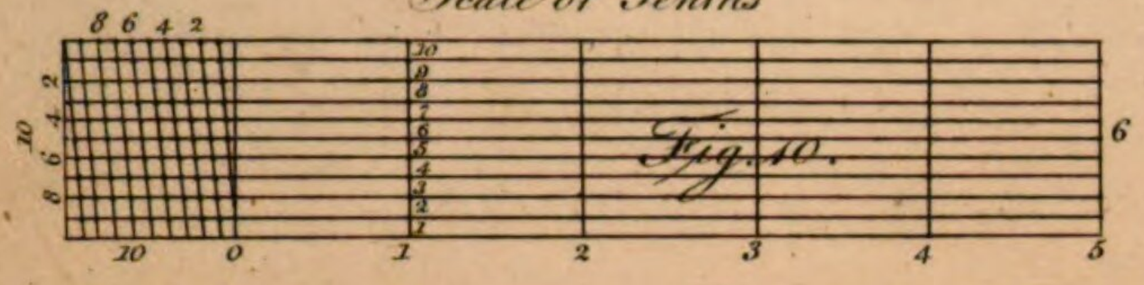
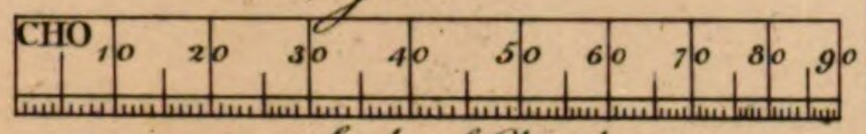


Fig. 10.

Fig. 11.



Scale of Chords

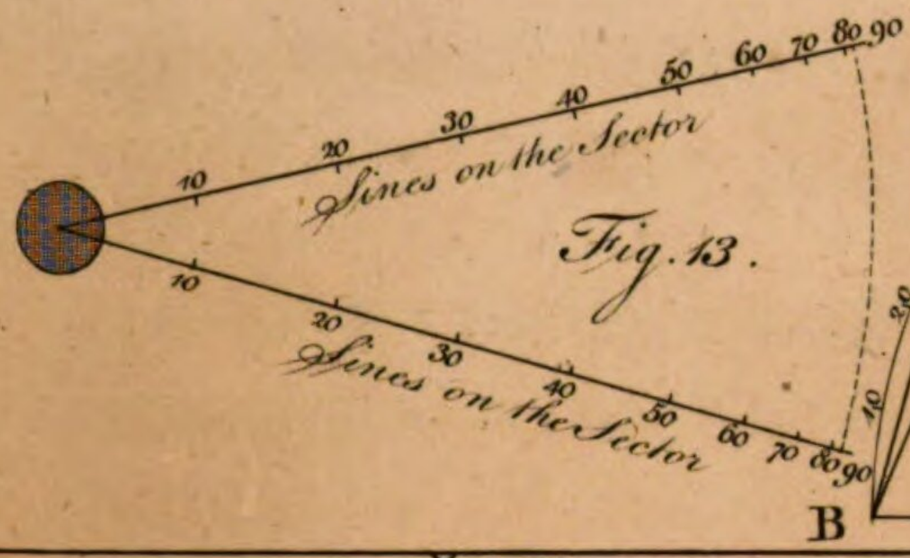


Fig. 13.

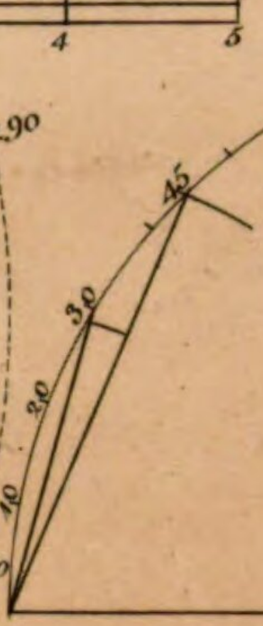
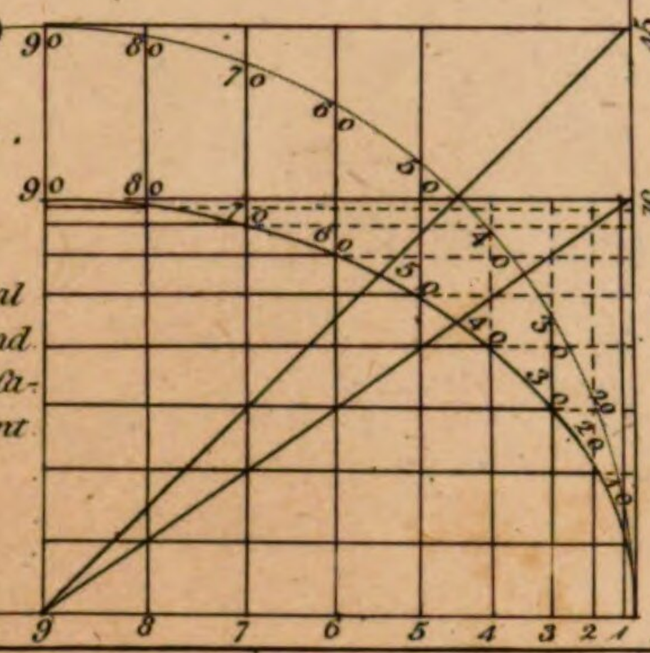


Fig. 12.



To draw an Oval by the Sector and How to mitre a Cavetto, of different projections.

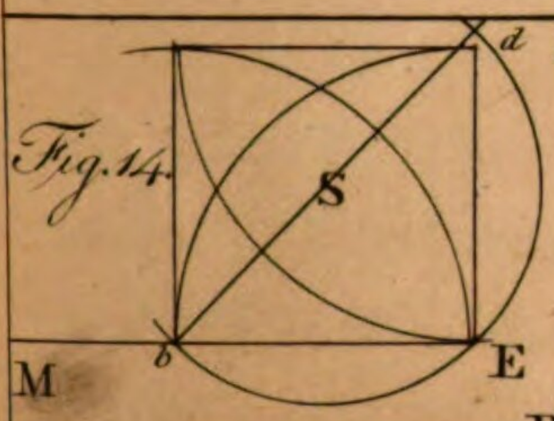


Fig. 14.
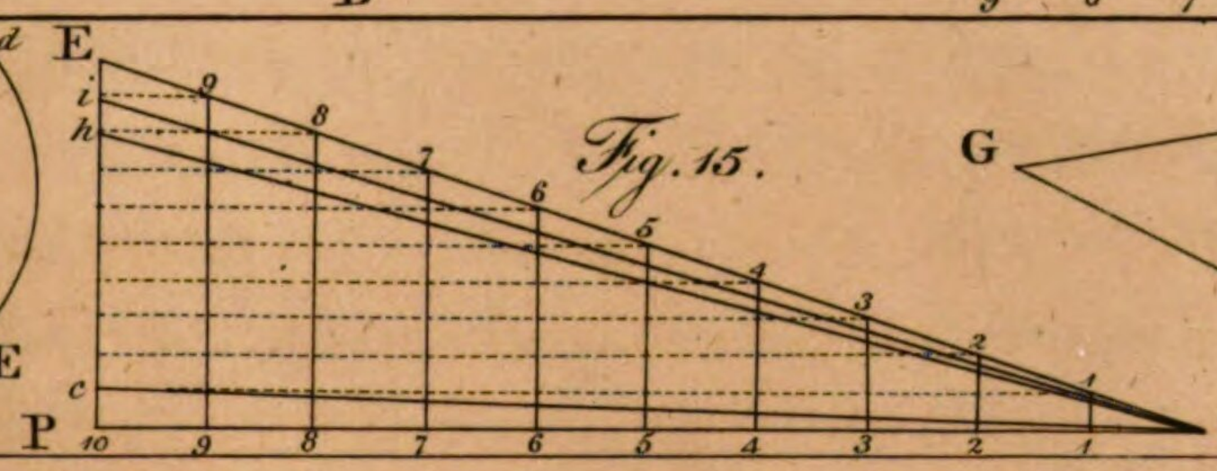


Fig. 15.

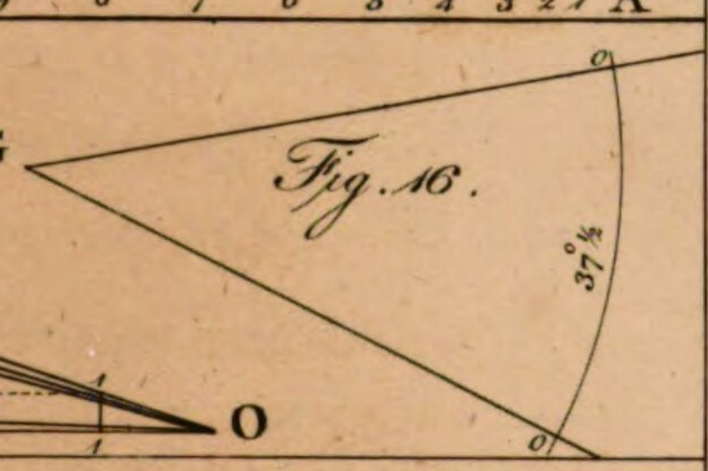
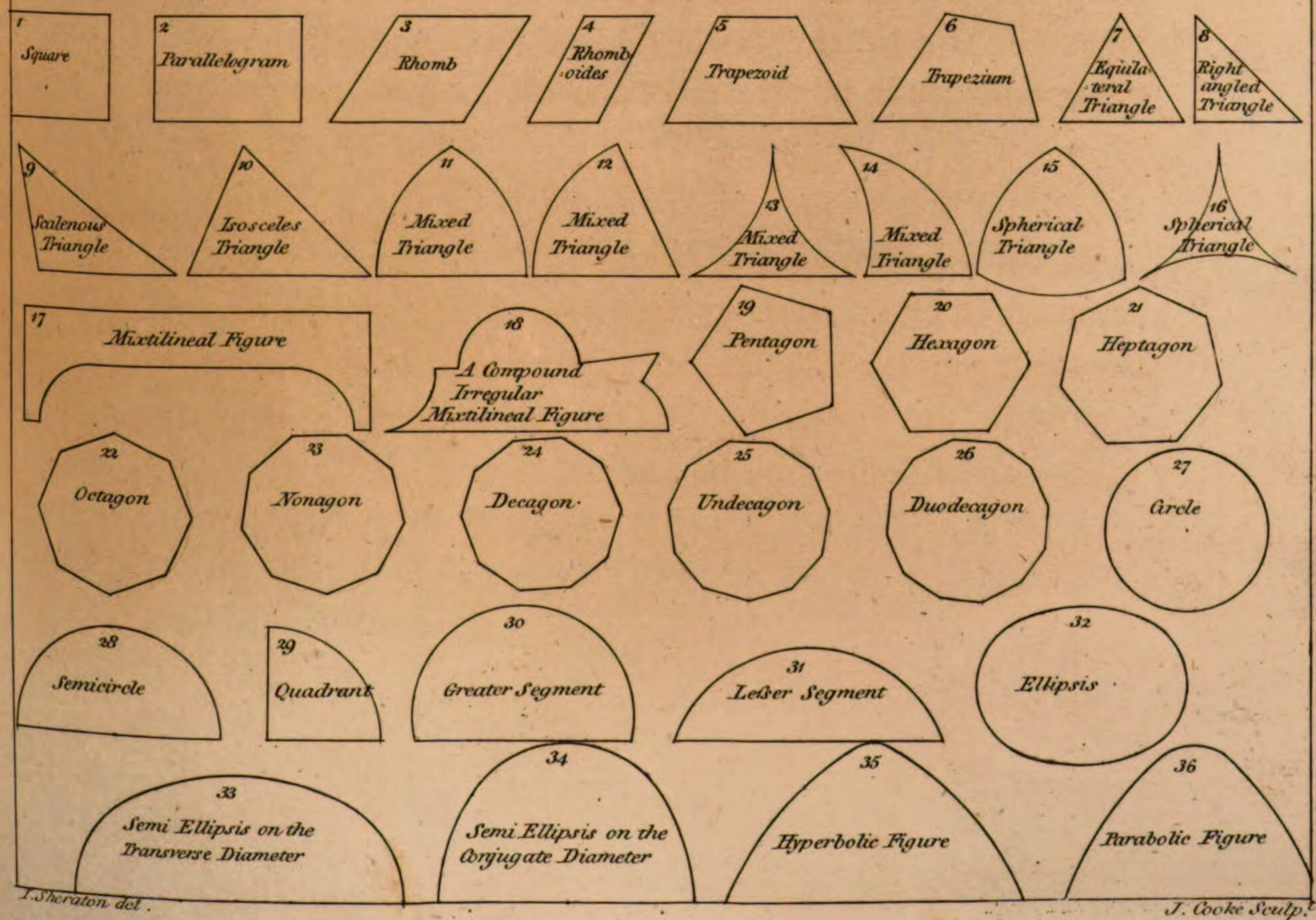


Fig. 16.

Various Geometrical Figures, & their Names.



I. Sheraton del. J. Cooke Sculp.t

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PROB. VII. FIG. 19.

How to draw the Polygons.

To draw a Pentagon whoſe ſides ſhall be equal to a given length, as the line 12.1, Fig. 19, Plate III.

Operation.—Draw a right line 12.1, and take the ſide 12.1 of the propoſed Pentagon. Place one foot of the compaſſes on 12, and with the other ſweep the arch 1.1. Again, place the compaſs foot on 1, and ſweep the arch 12.1, and through the point where theſe arches meet raiſe a perpendicular line, and continue it at pleaſure. Divide the arch 12.1 into ſix equal parts. Take then the firſt of theſe parts, and ſweep it to the perpendicular line downwards, as the figure clearly ſhews; and from this point on the perpendicular line extend the compaſſes to 12, which will be the radius of a circle that will contain 12.1 five times: therefore, with the compaſſes thus fixed, deſcribe the circle, Fig. 20, and it will admit of 12.1 five times, forming a regular Pentagon.

And here it ſhould be obſerved, that what has been done in this Problem for drawing a Pentagon, prepares the way for drawing any Polygon up to 12, whoſe ſides are equal to 12.1: therefore, in deſcribing the other Polygons, I ſhall proceed as being thus far advanced.

PROB.

PROB. VIII. FIG. 19.

To deſcribe a Hexagon, whoſe ſides ſhall be equal to any given length.

Operation.—Take 12.1, the ſuppoſed dimenſion of the ſide of the Hexagon, and with this radius draw a circle, whoſe center is at the interſection of the two arches 12.1, 1.1, then will the radius turn ſix times on the circumference of that circle, as the ſmall daſhes which are on it ſpecify. It may be made a general rule without exception, that whatever the diameter of a circle be, its radius will always divide the circumference into ſix.

PROB. IX. FIG. 19.

To deſcribe a Heptagon, whoſe ſides ſhall be equal to any given length.

Operation.—Take one of the parts on the arch 12.1, and ſweep it to 7 on the perpendicular line. Extend the compaſſes from this point 7 to 12, which will be the radius of a circle that will contain the given ſide 12.1 ſeven times, which forms a Heptagon.

If an Octagon be wanted whoſe ſides are equal to 12.1, take

from

from the center two parts, and ſweep the arch 2.8. Laſtly, extend the compaſſes from 8 to 12, which, as before, will be the ſemi-diameter of a circle that will contain the given ſide 12.1 eight times, by which an Octagon may be formed.

In the ſame manner proceed with the other to a circle that will contain the given ſide twelve times, as the largeſt circle in the figure evidently does, as marked by the figures 1, 2, 3, &c.

In the preceding directions for drawing the Polygons, their ſides are previouſly determined as to their length, but the circle that will contain the ſides ſo many times, is required to be found. We ſhall now change the order, and propoſe a given circle, in which ſhall be inſcribed any Polygon of the above kinds.

Prob. X. Fig. 21.

Therefore a circle being given, let it be required to find the ſide of a Pentagon that may be inſcribed within the given circle.

Operation.—Let the line 9.5 be the diameter of the given circle.

Biſect the diameter, and draw a line at right angles with it; then with the radius 5 9 deſcribe the circle.

Second, Divide any of the quadrants of this circle into five equal parts, and a chord line extended to four of theſe parts will be the ſide of a Pentagon that may be inſcribed in the given circle, as the figure plainly ſhews.

Prob. XI. Fig. 21.

To find the ſide of a Heptagon that will inſcribe within a given circle.

Operation.—Let Fig. 21 be the given circle as before. Divide any of the quadrants into ſeven, as the under right hand one in the figure.

Take then four of theſe diviſions in your compaſſes, and the whole circle 21 will contain it ſeven times, which forms a Heptagon.

In this way proceed with the other Polygons, always obſerving, that whatever number of ſides the Polygon is required to have, the quadrant of the given circle muſt be divided into the ſame number of equal parts, and four of theſe equal parts muſt always be taken for the ſide of the Polygon without exception. This is exemplified on each quadrant of the circle, which has already been referred to, and, by a little inſpection and reflection, cannot fail to be underſtood.

The

The ſimplicity of this method of inſcribing Polygons in any circle, makes it highly uſeful to all who are any way concerned with deſcribing ſuch figures on an extenſive ſcale. For inſtance, how eaſy is it to lay down the plan of any room, or mark out the foundation wall for any building of theſe figures, by firſt drawing a circle equal to their reſpective areas, and dividing the quadrant of that circle into the ſame number of equal parts as the room or building has ſides; and then taking four of thoſe parts for each ſide of the building or room.

From theſe hints the Cabinet-maker alſo will eaſily apply this method to any table-top, or other piece of work that is required to be made of theſe figures.

Of the various Methods of deſcribing Ovals.

PROB. XII. FIG. 22.

To draw an Ellipſis by the interſection of two circles.

Operation.—Let the line B A be the tranſverſe, or long diameter, which divide into three equal parts. Take one of theſe parts for the radii of the two circles, and on the centers *d* and *s* deſcribe the circles interſecting each other at *n n*. Draw from

n a right line through *d* to *b*. From *n* draw *n s* to *e*, and ſo of the other ſide. Place the compaſs foot on *n*, and extending the other to *b*, ſweep the arch *b e*. Laſtly, fix the foot of the compaſſes on the other *n*, and ſweeping the oppoſite arch, the oval will be completed.

Prob. XIII. Fig. 23.

To draw an Oval whoſe tranſverſe diameter ſhall be equal to the diameters of two given circles.

Operation.—Draw C D equal to two diameters of a given circle. Sweep the circumferences of the two circles. Then from the center of each circle, with the compaſſes in the ſame poſition as when the circles were drawn, ſweep two arches, *s d p* and *p o s*, interſecting in the points *s* and *p* *.

To complete the Ellipſis, fix your compaſs foot on *s*, and extend the other to *n*; ſweep the arch *n r*. Laſtly, fix the compaſs foot on *p*, and ſweep the oppoſite arch, and the work is done.

* It is evident that the angles *s d p o* form a rhomb compoſed of two equilateral triangles *d s o*, *p d o*, which method of drawing a rhomb of that degree of inclination is moſt quick and certain. The ſame obſervation might have been made on the firſt oval, but this being more diſtinct, I choſe to mention it here.

The

The method of drawing theſe two kinds of Ovals ſuppoſes that we are only confined to the length of the long diameters, without regard to the ſhort one; but the following Problem is to draw an Oval of any length and breadth as may be required.

PROB. XIV. FIG. 24.

To deſcribe an Ellipſis whoſe tranſverſe and conjugate diameters are pre-determined.

Operation.—Let E F be the tranſverſe, and *a o* half the conjugate. Take *a o* half of the ſhort diameter, and place it on E *d*. Divide then the remaining part of half the long diameter into three equal parts, as the figure ſhews, and take one of theſe three parts and lay it on the other way, as from *a* to *n*. Take the diſtance from *n* to *o*, and lay it from *o* to *g*. Extend then the foot of the compaſſes from *g* to *n*, by which ſweep two arches each way, interſecting each other at *p o*. From *o* to *n* draw a right line out at pleaſure. Do the ſame from *o* to *g*, and alſo from *p* to *n* and *g* on the oppoſite ſide; then will every center be found for each reſpective arch. From the center *n* extend the compaſs foot to E, and ſweep the arch E *b*. Do the ſame from *g*, and ſweep the arch *m* F. Laſtly, from *o* extend the compaſſes to *b*, and ſweep the arch *b m*; and ſo of the other ſide, which will complete the Ellipſis as required.

PROB.

PROB. XV. FIG. 26.

To draw an Oval of any length and breadth by means of two bradauls and a chalk line.

The above methods for drawing ovals ſuit well for ſmall ovals deſcribed on paper, or any kind of metallic ſurface, when very ſmall ovals are wanted to be drawn on wood. But when ovals of a large ſize are wanted, they become inconvenient on account of their centers. Therefore Cabinet-makers generally make uſe of a tramel, by which any oval from two to about four feet may be drawn, both with more diſpatch and accuracy than can be done by any other method. The method, however, which is here propoſed, is not without its advantages, ſince by it an oval may be drawn as large as we pleaſe, both with little trouble and conſiderable exactneſs, provided that materials ſufficiently ſtrong and large enough were ſubſtituted in place of the bradauls and chalk line.

Operation.—Let B D be the length of the oval, and A *s* half the ſhort diameter. Take then half of the longeſt diameter, and place it from A to *a* till it touch the line *a s* exactly at *a*. Again, take the length *a s* and place it on the right hand at the bradaul; then will the two centers be found in which the bradauls are to be fixed. Laſtly, take a line and put it about the

the two bradauls, and bring the ends of the line exactly to A, at which point fix your pencil or piece of thin chalk, and begin to deſcribe in the manner that the hand exhibits, and the pencil, &c. will paſs through the points D B A as required.

I have found the preceding method vaſtly convenient in marking out the circular ends of a ſet of dining-tables; in which caſe there is always an opportunity of ſticking in the bradauls at one ſide of the board, after a line has been ſtruck to make the edge of the board ſtraight. Then, after drawing a perpendicular line by a ſquare and pencil from half the length of your dining-table top, proceed as above, and you may draw the ſemi-ellipſis juſt to ſuit the breadth of the board, if it is ſo required.

Prob. XVI. Fig. 27.

To deſcribe an Oval by Ordinate Lines.

Where an Oval is wanted to be deſcribed on a ſmooth ſurface that will not admit of any inciſion or rough mark, the following method may be recommended.

Operation.—Draw the inſcribed circle in Fig. 27 on a ſeparate board or paper, that the compaſs foot may not mark the ſmooth ſurface. Divide one ſemi-diameter of this circle into

any convenient number of equal parts. From theſe diviſions (ſuppoſe four) raiſe perpendicular lines to the Periphery* or circumference, which are called the Ordinates of that circle. Obſerve, the diameter of this circle is always equal to the conjugate diameter of the oval.—Proceed now to draw a line on the ſuppoſed ſmooth ſurface, on which to determine the length of the long diameter; which divide into the ſame number of equal parts from the center each way as the ſemi-diameter of the circle is divided into. From theſe diviſions draw lines acroſs, as the figure ſhews. Number the ordinates of the circle, as 1, 2, 3, 4, and do the ſame to thoſe of the intended oval. Take then the compaſſes, and fixing one foot in 1 on the circle, extend the other to the point where that line touches the circumference. Transfer this opening of the compaſſes to the lines 1.1 for the oval, and make a pencil mark at the point each way from the diameter. Take the ordinate 2 from the circle, and place it each way from the diameter on the ordinates 2.2 for the oval, and mark the points with a pencil as before. In this way proceed till all the ordinate lines are taken from the circle and transferred to their correſponding ordinates for the oval; after which nothing will remain but to draw a ſmooth curved line through each point, and the oval will be complete.

* Periphery, from περι, *peri*, about, and φερω, *phero*, I bear or carry; which derivation, if I am not miſtaken, alludes to the hand bearing the radius about its center, in order to deſcribe the circumference of the circle.

PROB.

PROB. XVII. FIG. 28.

To draw an Oval by means of a notched piece of wood and a ſquare.

I propoſe this method as a good make-ſhift, where a proper tramel is not to be had, and when, perhaps, the method of drawing ovals by the foregoing rules may have eſcaped the memory, and no book near at hand to aſſiſt it.

Operation.—Let *f i* be the long diameter, and take any ſquare, by means of which draw the line *e t* at right angles, or ſquare with it. Then notch out a piece of thin deal, as *a g*, to ſuit the thickneſs of the ſquare, ſo that the bottom of *g* may reſt on the ſurface of the oval, and not prevent *a* from paſſing in the circumference *f e*. From the pencil point near *a* to the end near *g* muſt be equal to half the long diameter *g f*, and from the notched part *a* to the pencil point *a* muſt be equal to half the ſhort diameter *e g*. Laſtly, place your ſquare, and with one hand keeping it unmoved on the two diameters, by the other ſweep the elliptic arch *e f* for one quarter. How to proceed to the other quarters muſt be evident to every one, and therefore it is unneceſſary to ſay more.

The truth of this method will appear to every one by

obſerving, that if *b*, which is the end of the notched wood or tramel ſtick, is moved gradually to *g*, the internal angle of the ſquare, then will the pencil point be at *f*, becauſe from *b* to the pencil point is equal to *f g*, half the long diameter: and again, if *a*, at the notch, be gradually turned to *g*, the inner angle of the ſquare, then will the pencil point be at *e*, becauſe from *a* to *a* is equal *g e*, half the ſhort diameter.

I have already ſhewn the method of drawing an oval by the ſector in Section II. page 38, and therefore I need not ſay any thing on it here.

PROB. XVIII. FIG. 30.

To find the center and two diameters of any Oval whoſe circumference is already given, and whoſe center and diameters are eraſed or rubbed out.

Operation.—Let *m i q g* be the circumference of the oval.

Draw the right line *o q* at random, and draw *m n* any where parallel to *o q*, by means of two arches, as the figure ſhews.

Second, Biſect the line *m n* from its interſection with the circumference of the oval, as at *s*. Alſo biſect *o q* in the ſame manner

manner as at *s*. Draw the line *i g* through *s s*, and from where *i g* cuts the oval, biſect *i g*, as at the center *s*.

Third, On the center *s* deſcribe any circle large enough to interſect the circumference of the oval, as at the points *c b*. Draw the line *c b*, and biſect it, as at *u*; then draw the long diameter *a b* through *u s*, the center; and, laſtly, draw *e d* parallel to *c b*; then will *e d* be the ſhort diameter, *a b* the long one, and *s* the center, as required.

This Problem will be found uſeful in many caſes. For inſtance, when the face of a fire ſcreen is a true oval, and it is required to put the braſs ſprings on it after being covered with paper or ſilk, &c. in this caſe it will be very uncertain whether the oval will hang true, if the ſprings are only put on by gueſs.

To avoid uncertainty, take a ſheet of paper and lay on the face of the ſcreen, drawing a pencil round its circumference, from which proceed to find the diameter as above.

Prob. XIX. Fig. 17.

To find the Center of any ſegment or complete circle whoſe circumference is already given.

Operation.—Let B D A be the ſegment whoſe center is re-

quired. Draw the chord lines A D, D B, any how at random. Biſect the chord A D by ſweeping two arches from the points A and D, as the figure ſhews. Do the ſame to D B. Laſtly, draw the right lines *e d* and *a b* through the interſections of thoſe arches, and where theſe two lines meet in a point, as at *c*, will be the center as required.

It is evident, if *c* be the true center of the ſegment B D A, that it will alſo be the true center of any complete circle of the ſame radius.

It is likewiſe farther evident, that if the chord lines A D and D B were conſidered as two ſides of any regular polygon, the ſame method would have the ſame effect in finding its center.

The above Problem will be of uſe to the workman, when it is required of him to fit up a board into the inſide of an arch, in order to aſcertain its true ſweep.

To this end, let the line B A repreſent a lath laid acroſs the foot of the arch A D B, to find the length of its opening. Then find the middle of this lath, and from the middle of it put up another perpendicular to it, as D, to find the depth of the arch. After having proceeded thus far, take the board to be fitted up, and make one edge of it ſtraight, and draw a

ſquare line acroſs it, on which lay on the depth of the arch, as at the point D. From D draw the chord lines D A and D B, biſecting them as has already been taught, and the true center will be found for the ſweep of the arch; which ſweep, if it be exactly ſawn, will fit the arch A D B, as required.

Prob. XX. Fig. 18.

To find the Diameter of a Cylinder, when its ends cannot be meaſured, or of a circular building, when no dimenſions can be obtained from its inſide.

Operation.—Let the circle, Fig. 18, be conſidered as the circumference of the cylinder, and let *h k* repreſent a ſtraight rod, touching the outſide of the cylinder. From any of the diviſions on the rod *h k* put another rod acroſs, till it touch the outſide of the cylinder in a ſquare direction from the rod *h k*; which is eaſily done, by keeping the croſs rod exactly by the ſide of the ſquare lines which mark out the diviſions. So the lines *g h* and *i k*, repreſenting the croſs rod, are in a ſquare direction from the long rod, and are produced till they touch the cylinder.

After proceeding thus far, take paper, or a drawing-board, as may be required, and draw a right line equal in length to *h k*,

as

as *h m k*, No. 2. From *h m k* draw *g h* and *i k*, of the ſame length and direction, as *g h* and *i k* in Fig. 18. Draw then the chord line *g m* at random, and from the point *m* draw *m i*, the other chord. Biſect thoſe chords, as the figure ſhews, and where the right lines meet in a point will be the center of the cylinder; and any right line being drawn through the center *s* will determine the length of the diameter as required.

Thus it is evident that the diameter, and conſequently the circumference of any round building, may be aſcertained by this method.

The lath *h k*, in ſuch a caſe, may be conſidered ten feet long, and five inches broad, and each of the diviſions on it one foot: and proceeding in the manner taught above, the moſt accurate dimenſions of the diameter of any ſuch building will be found.

SECTION

SECTION V.

On various useful Problems pertaining to the working Part of both the Cabinet-making and Upholstery Branches: as the Methods of mitring Mouldings of different Projections—of drawing large Circles, without the Trouble of extending a Lath to their Centers, to sweep their Circumferences by—of drawing sweep Cornices, and fitting up their Valances to the Cornices—of mitring the raking Mouldings of Pediments—and of the Manner of planing a Room to cut a Carpet by.

PROB. XXI. FIG. 15. Plate II.

THE extreme lines P E and P 1 being given, let it be required to find any number of mean proportional lines at equal distances from each other.

Operation.—From the points of the extreme line E P to the points 1.1 of the other extreme draw right lines which will meet in O. Then let it be required to find eight mean proportionals, placed at equal distances from each other. Divide the extreme line P E into ten equal parts, which is allowing one

part

part for each extreme. Draw the line *i* 9 parallel to the line P O, cutting E O in 9. Again, draw *h* 8 in the ſame manner, cutting E O in 8; and ſo of all the reſt, as 7, 6, 5, 4, 3, 2, 1. Through each of theſe points 9, 8, 7, 6, &c. draw lines parallel to P E, as the figure ſhews; then will the lines 9.9, 8.8, and ſo on, be the mean proportionals as required.

Obſerve, in whatever proportion the extreme line E P is divided, into the ſame proportion will the hypothenuſe line E O be divided when lines are drawn parallel to the baſe line P O from the reſpective diviſions on E P. Therefore if E *h* be one-fifth part of the line E P, then is *h* 8 one-fifth of the baſe line P O, and E 8 one-fifth of the hypothenuſe E O. Alſo if E *c* be nine-tenths of the line E P, ſo will a line from 1 to E be nine-tenths of the line E O, and the perpendicular line 1.1 will be one-tenth of the line E P; ſo the line 2.2 will be two-tenths of it; and ſo on proportionally of all the reſt.

From this little theory, the following practice may be deduced.

If it be required to make a ſtep-ladder of inclined ſides, as they generally are, or any thing of the ſame nature, it is evident, from what has been ſaid, and from what may be ſeen in the figure, that the ſteps may all be cut to their proper lengths,

before

before the ladder be put together in any part of it, which of courſe ſaves both wood and time.

To cut the ſteps to their proper length, proceed as follows. Take a piece of deal, two or three feet long, and plane it over, making at the ſame time one of its edges ſtraight. Then determine how much the ladder is to bevel off from bottom to top. Take the difference, and having drawn a ſquare line from the ſtraight edge of the board, place the beveling difference, ſuppoſe ſix inches, upon this line, which, in the figure, is repreſented by the line E P. Draw a line, as from E to O, ſuppoſe ſix inches in length. Draw then the center line of each ſtep from the edge of the board, at equal diſtances, as the line 9.9, 8.8, &c. then will the difference of the lengths of theſe perpendicular lines be equal to the difference of the length of each ſtep; that is, the ſtep 8 will be the ſpace between *i* and *h* ſhorter than the ſtep 9, and ſo on to the laſt ſtep 1.1, which will be all the ſpace between *i* and *c* ſhorter than 9, as is evident from inſpecting the figure.

To find the bevel of the ſtep-ends, divide E P, ſuppoſe ſix inches, in the ſame ratio or proportion as the ſide of the ladder is divided into. If the ſide pieces of the ladder be ten feet long, take one foot and place it by the edge of the before-mentioned board. Then divide the bevel of both ſides of the ſtep-

ladder, ſuppoſed to be ſix inches, into ten, and take one-half of the tenth of the ſix inches, and a line to a full foot in length will give the true bevel for all the ſteps. Laſtly, when the ſteps are all plained, run a gage on the middle of their edges: upon this gage ſtroke muſt be placed the different lengths of the ſteps, and the bevel for their ends muſt be ſtruck acroſs from their reſpective extremities.

Thus it will be evident to any thinking workman, that all the ſteps may be finiſhed for putting together before the ſides of the ladder are begun; and how to proceed with theſe need not be mentioned.

From the above little theory may alſo be deduced a uſeful practice in perſpective, when vaniſhing lines exceed the picture; but this muſt be reſerved for the ſecond part of this work, in which I ſhall treat of that art.

PROB. XXII. FIG. 29. Plate III.

To draw an Elliptic Cornice of any given length or depth, and to fit the valance to it.

Operation.—Let *o p* be the depth of the cornice with its facia, and make *o* 10 half the length of the cornice; draw the

quadrant

quadrant *p* 2, and divide its chord into nine equal parts, from whence draw lines perpendicular from the baſe of the quadrant till they cut the circumference. Divide then the half length of the cornice into ten, and draw perpendiculars from each reſpective diviſion, marked 1, 2, 3, 4, &c. From the diviſions or points on the circumference of the quadrant draw lines parallel with the baſe line 10 *o*, till they cut the perpendicular line to which they belong; that is, from 8 on the circle draw a parallel line till it touch the perpendicular 8, and from the reſt do the ſame, which will form ſo many points on the reſpective perpendiculars as will be a ſufficient guide for an elliptic arch to paſs through. Obſerve, the ninth diviſion is ſubdivided, by which another point is gained in the quick part of the ellipſis, for the convenience of drawing the ſweep more perfectly. The proportion of the hances may be eaſily aſcertained, as the figure ſhews; but in this particular fancy will generally be the rule.

Method Second.

It has already been obſerved, that the chord line of the arch 2 *p* is divided into nine equal parts, from which lines are drawn till they touch the circumference; after which draw the line *p* 9, as a correſpondent chord for the elliptic curve, and divide it into the ſame number of equal parts as the chord of the circle is divided into. Then take, for inſtance, the length of

the perpendicular line 8.8 in the circle, and transfer this to the perpendicular line 8 on the other chord, and mark it with a pencil. Again take 7.7 from the chord of the circle, and transfer it to 7 on the other chord, and mark it as before. In this way proceed till all the perpendicular lines on the chord of the circle are placed on the correſpondent perpendiculars on the elliptic chord, and nine points will be obtained through which the curve is to paſs as before.

To fit up a Valance to a Cornice of the above Kind.

The ſtuff for the valance ſhould be tacked ſtraight on a board, and with a piece of ſoft chalk draw a line anſwerable to the line 10 *o*, or bottom of the facia. Divide the facia of the cornice in the manner ſhewn in the figure, and draw ſquare lines up to the cornice: do the ſame on the ſtuff for the valance, and take from the cornice the length of each perpendicular line *o*, 1, 2, 3, &c. &c. and transfer thoſe different lengths to their reſpective perpendiculars on the ſtuff, and mark them with chalk. Laſtly, by a ſteady hand draw, with ſoft chalk, a curve to paſs through theſe points, which, if accurately done, and cut by the line, muſt evidently fit at the firſt trial.

PROB.

PROB. XXIII. FIG. 31. Plate III.

To deſcribe the Arch of a Segment of a large Circle, without the aſſiſtance of a lath from its center.

Operation.—Let Fig. 31 be conſidered a ſegment, whoſe chord is twenty feet long, and its ſwell two feet, as the perpendicular C 10. Draw then a ſemi-circle, whoſe radius ſhall be equal to C 10. Divide one quadrant into ten equal parts, and into the ſame number divide half the chord A C. From each diviſion on A C raiſe perpendiculars, as 1, 2, 3, and ſo on. From 9 on the quadrant draw a line parallel to A C, till it touch the perpendicular 9, and mark it with a point. Again, from 8 on the quadrant draw a parallel till it touch the perpendicular 8, and mark it as before; and ſo on, from 7 to 7, 6 to 6, till the whole are done. Through the points on the ſeveral perpendiculars draw, with a ſteady hand, a curve line paſſing through theſe points, and it will form a regular arch.

Method Second. (On the right hand of Fig. 31.)

Operation.—Draw the chord of the quadrant, and divide the ſame chord into ten equal parts, and raiſe from theſe equal diviſions lines perpendicular to the chord, till they touch the quadrant

quadrant arch. Divide the line C B into ten equal parts alſo, and from 10 perpendicular to C, draw the line 10 B. On the chord of the quadrant take your compaſſes, and fixing one foot on the perpendicular 9, extend the other foot to the point where the ſame perpendicular touches the arch. Transfer this to the other 9, and make a pencil mark. Again, place one foot of the compaſſes on 8 of the chord of the quadrant, and extend the other foot to the point where the perpendicular cuts the arch. Transfer this alſo to the other 8, on the line 10 B; and in this way proceed for all the reſt, drawing a curve line through the reſpective points thus found, which will form a regular arch as before.

PROB. XXIV. Plate IV.

To take the Plan of a Room in an accurate manner, ſo that a Carpet may be properly cut by it.

Operation.—The room being cleared of every obſtruction, and the floor ſwept clean, proceed as follows:

Firſt, Take a chalk line, and by it ſtrike a line parallel to that ſide of the room which ſeems freeſt from irregularities, as *d c*, in Plate IV. Then by Problem III. page 23, raiſe a perpendicular from *c* continued to *b*. Proceed next to the other end of the room, as at *d*, and by the ſecond method of Pro-

blem

Plate 3.d

Fig. 17.

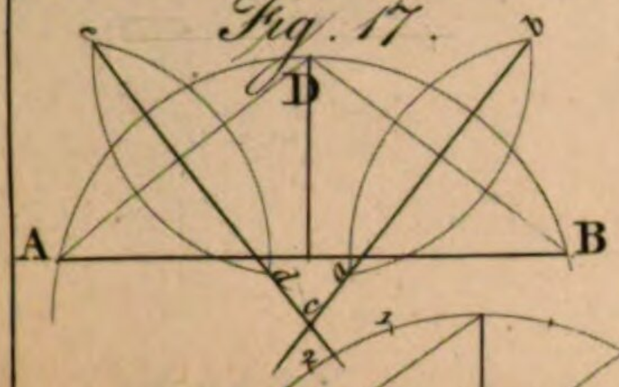
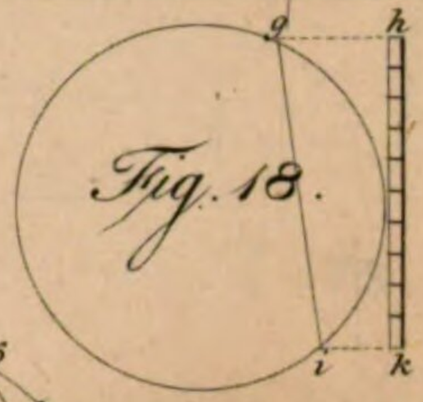


Fig. 18.



N.o 2.

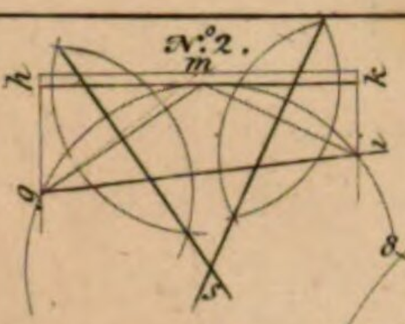


Fig. 19.

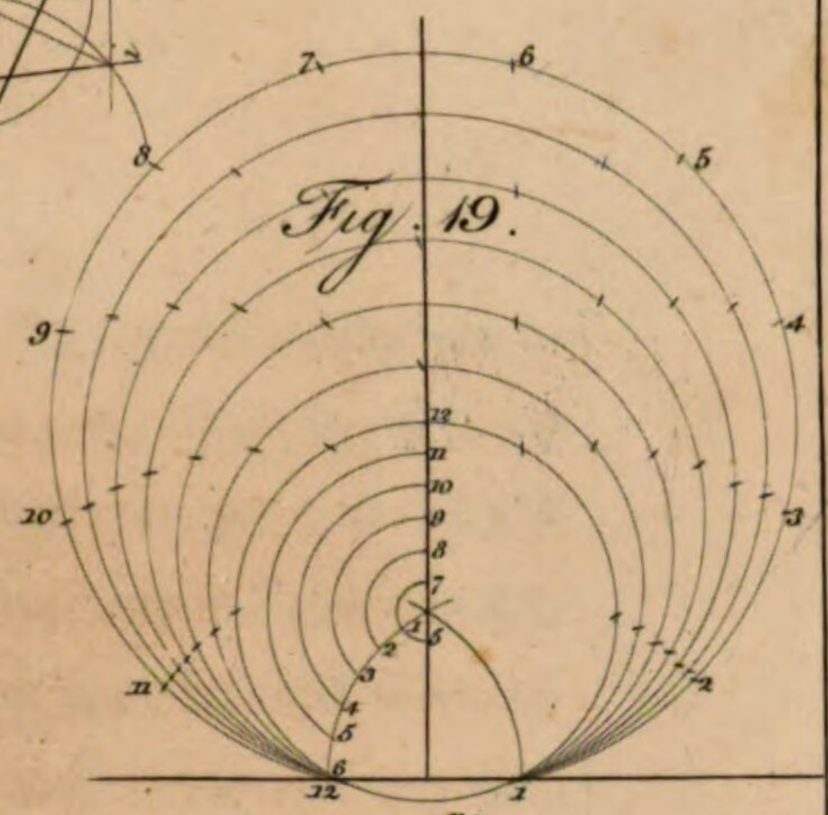


Fig. 21.

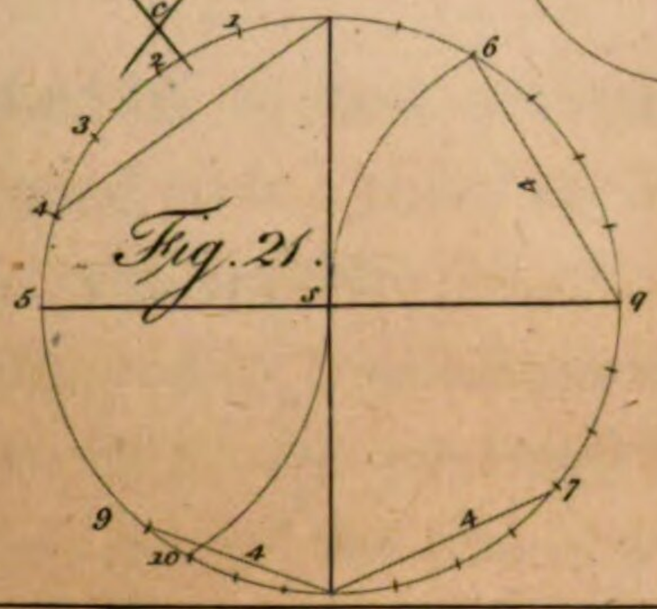


Fig. 20.



Fig. 22.

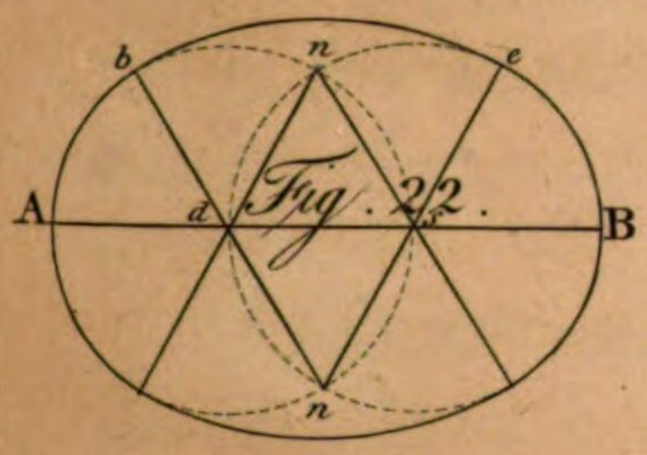


Fig. 23.

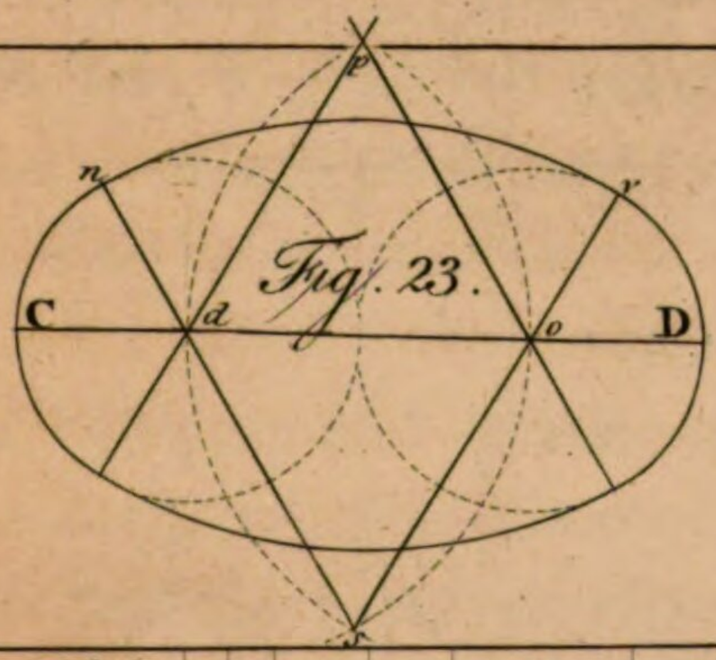


Fig. 24.

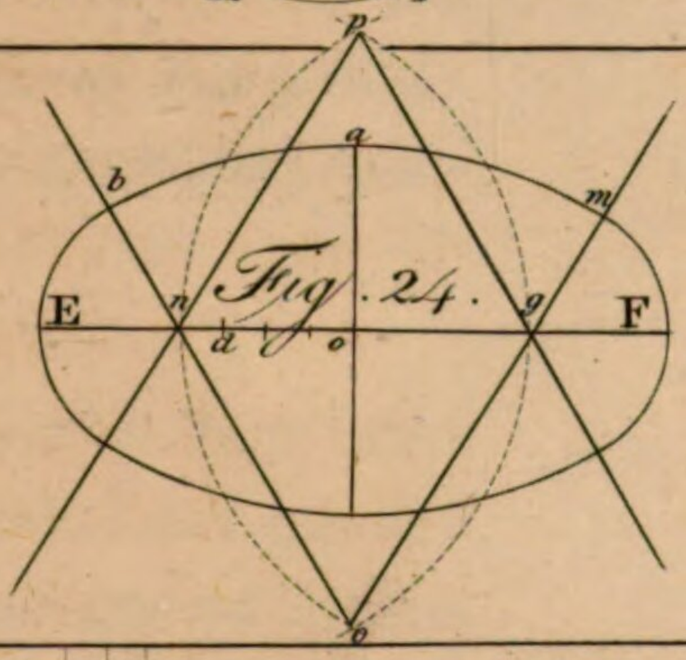


Fig. 26.

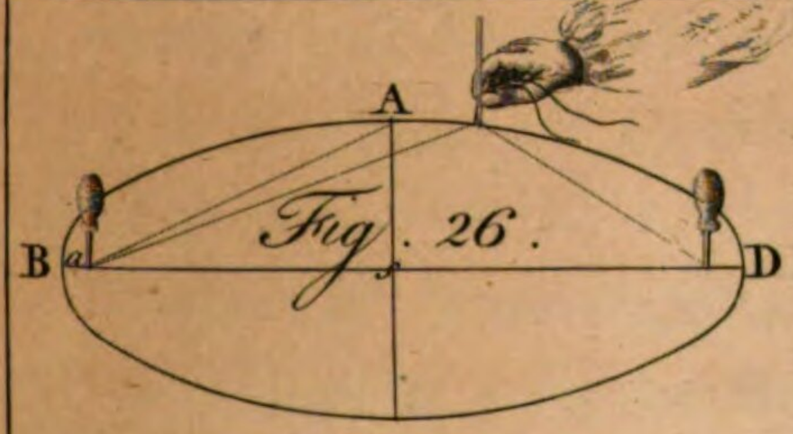


Fig. 27.

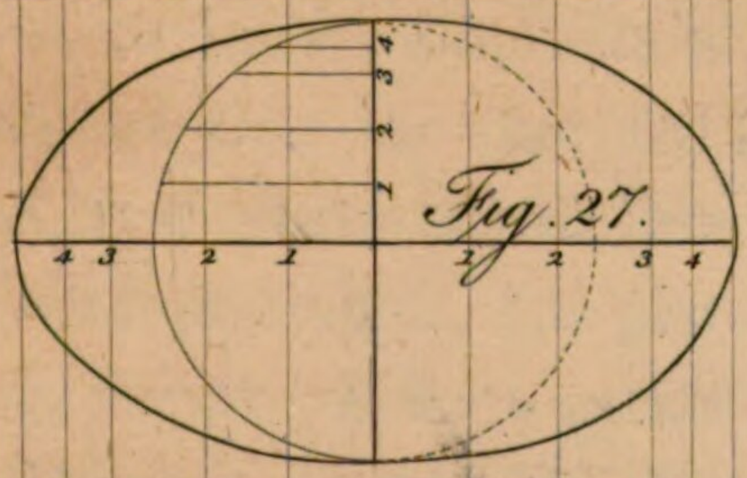


Fig. 28.

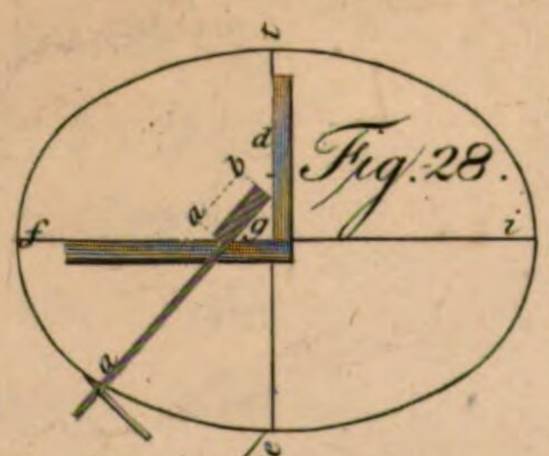


Fig. 29.

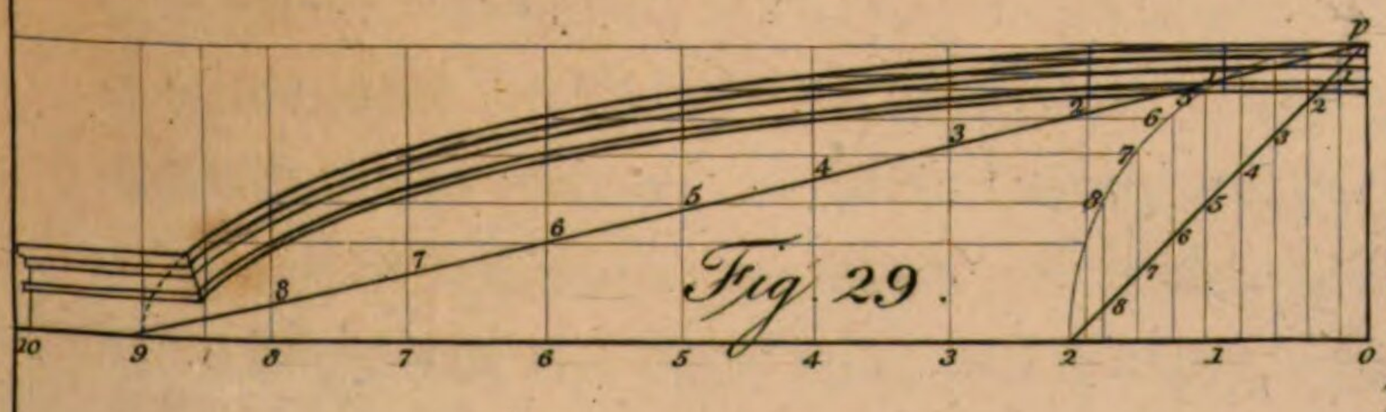


Fig. 30.

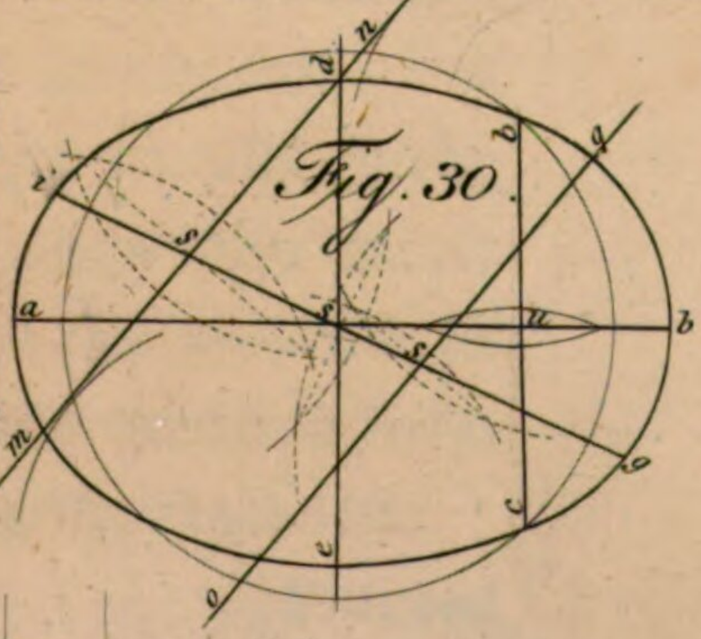
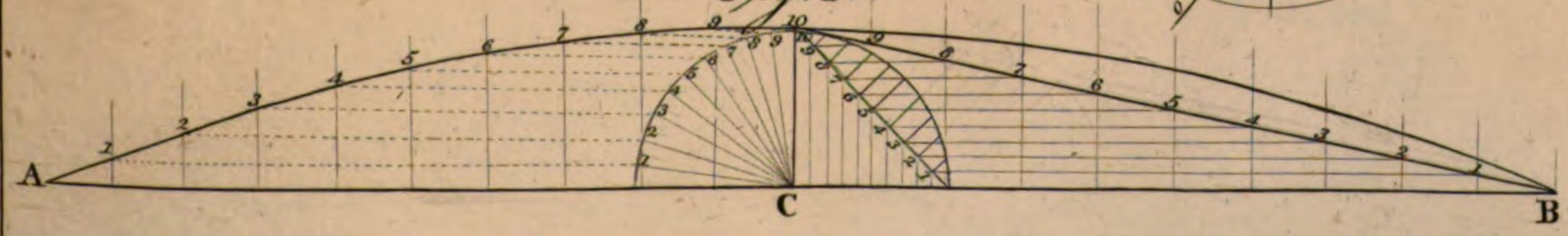


Fig. 31.



J. Cooke Sculp.t

T Sheraton del.t

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blem III. if moſt convenient, raiſe another perpendicular continued to *a*. Draw then a line from *a* to *b*, exactly parallel to *d c*, the oppoſite ſide of the room. Then will the angles *a b c d* form a true Paralelogram, proportioned to the ſize of the room, by which the principal diſtortions or irregularities of any of the ſides of the room will at once appear. For inſtance, the angle *v* is ſomewhat out, as the line parallel to *a d* plainly ſhews: and in this manner any other angle of the room, whether obtuſe or acute, may be aſcertained.

Second, Let the hexagon end of the room be next conſidered; and let it be obſerved, that the plan-taker is ſuppoſed to have no ſquare, or ſtraight rule, but only a caſe of inſtruments and line. Therefore, in order to know how much the ſide *i l* bevels off from a ſquare, take the line and ſtrike it by the ſide *i l* of the hexagon, and continue the line at pleaſure beyond *h*. Take then the braſs protractor, and place the center of its baſe to *i*, as the figure ſhews. Make a pencil mark over 90, on the arch of the inſtrument, and from *i* draw a ſtraight line acroſs the pencil mark to *g* at pleaſure. Take the ſide *i l* of the hexagon, and place it from *i* to *h*. Draw *g h* parallel to the baſe of the protractor, or to *b c*; then will *g h* ſhew how much *i l* is out of ſquare, as required. Examine then the other ſide of the hexagon by the ſame rule, and if there be any variation from the oppoſite ſide, it will eaſily be diſcovered by the ſame rule.

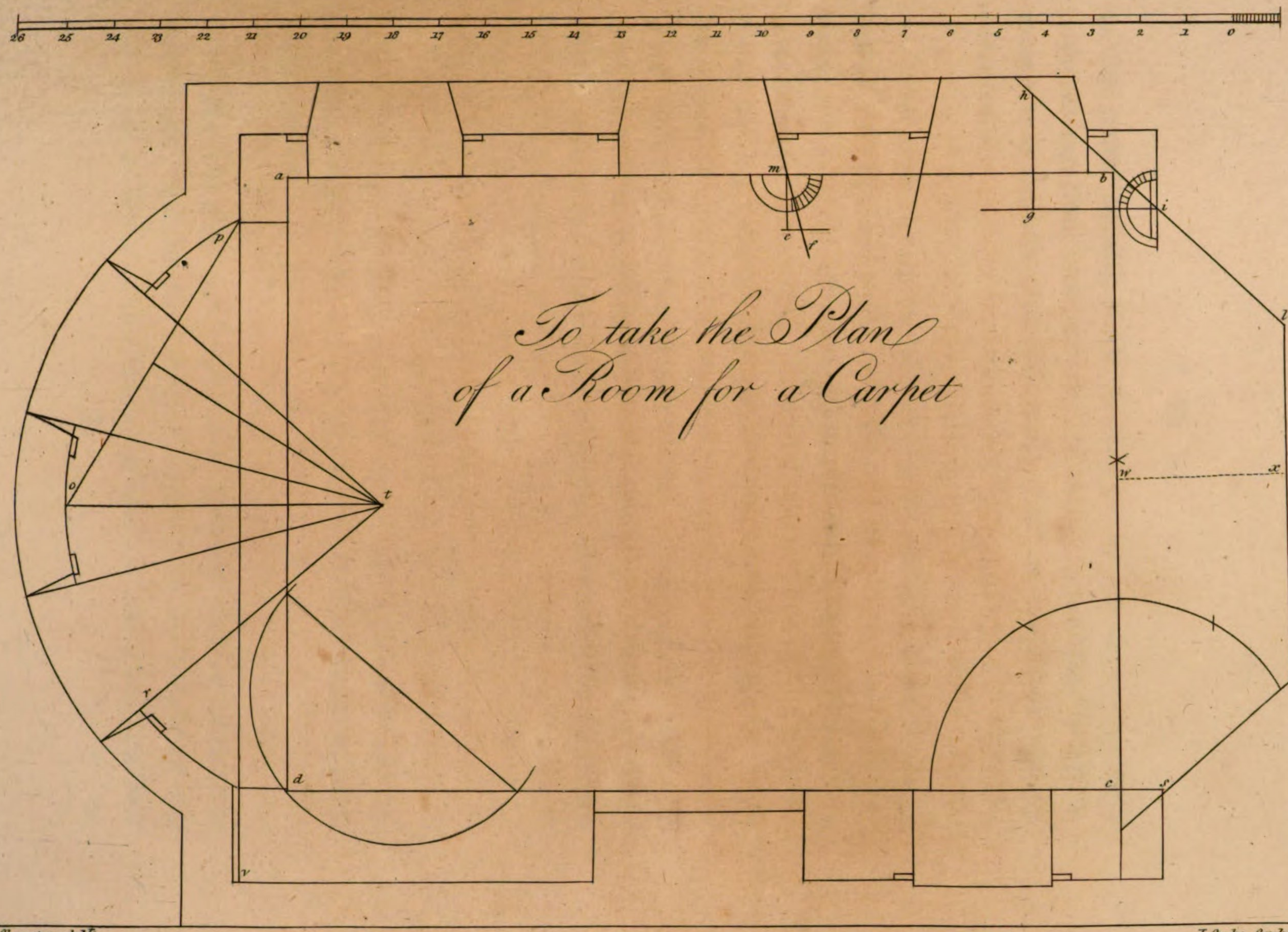
Proceed

Proceed to the windows, and find the rake of the jambs in the ſame manner as before, which needs not be repeated: only obſerve, that the protractor cannot be placed to the architraves becauſe of their irregularity; and therefore it muſt be placed on the line *a b*, as the figure itſelf expreſſes.

Laſtly, Proceed to the circular end of the room, with its windows; and in order to find the center of the arch *r o p*, draw *p v* at its foot, and parallel with *a d*. On the middle of *p v* raiſe a perpendicular, and continue it to *t* at pleaſure. Draw then the chord *o p*, and biſect it, whence raiſe a perpendicular, cutting *o t* in *t*, which will be the center. From the opening of each window draw the ſeveral radii, as ſhewn in the figure, by which it will be eaſily ſeen how much the jambs vary from theſe central lines.

The room being thus lined out, take a ſheet of paper, and lay down a ſcale of feet and inches that will comprehend the longeſt part of the room. Meaſure then with your common rule the ſides and ends of the Parallelogram which was chalked out on the floor, and whatever theſe meaſure by the rule, take the ſame number of feet, inches, and parts from the ſcale, and draw the Parallelogram on the paper in the ſame manner as was done on the floor: and in this way go on, taking off every dimenſion from the floor by the rule, and transferring them

to



To take the Plan of a Room for a Carpet

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J. Cooke Sculp.t

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to the paper by the ſcale; ſo that at length the paper will have all the lines and ſhapes which the room has, by which means it is evident that the moſt exact meaſurement will be obtained.

The next thing to be done is to provide a place large enough to lay down the full ſize of the room again. The order will now be reverſed at home; for thoſe meaſurements which were before taken from the room by a rule, and tranſferred by the ſcale on the paper, muſt again be taken from the paper by the ſame ſcale, and replaced on ſome convenient place, by the ſame rule that was uſed in taking the plan. If this method be purſued with accuracy, I am certain it cannot fail to anſwer the purpoſe, if a proper allowance be made for ſtraining the carpet.

Prob. XXV. Fig. 32. Plate V.

To mitre any thing of the nature of a Comb Tray, the breadth of whoſe ſides ſhall be given, and their inclination from a perpendicular predetermined.

Let *b a* be conſidered equal to the given projection of the ſide of the tray, and let the perpendicular *e a* be the height of the ſpring of its ſides. Draw the bevel line *e b*, and fixing one foot

of the compaſſes at *b*, ſweep the arch *e d*; then will *d* on the baſe line be the mitre point of the ſide of the tray *g l*, and *d b* will be the required breadth of its ſides, neceſſary to raiſe it to *e*, perpendicular over *a*, the point of projection. Again, if the tray ſide ſhould be required to be raiſed from its baſe up to *m*, then draw *m b*, which will be the breadth of the ſide, and with *b m* in your compaſſes, ſweep the arch *m n*; then will *n* be the mitre point of the ſide of the tray, as required. How much ſhorter the point *n* is than a full mitre, is ſeen from *n* to *o*, of the dotted lines meeting together.

Whence it is evident, that as the tray ſides are raiſed higher and ſtill higher from their baſe, the mitres will become proportionably ſhorter, till at length the ſides will be in an upright poſition, and conſequently muſt ſtand in a perpendicular direction from their baſe or bottom. On the other hand, if the ſides of the tray be depreſſed nearer to their baſe, and ſtill nearer, their mitres will proportionably increaſe, until they arrive at full length, and conſequently they will be in a perfect horizontal poſition, or parallel to their baſe.

A little reflection will eaſily convince the reader, eſpecially the Cabinet-maker, of the propriety and uſefulneſs of theſe remarks. How the edges of the ſides of the tray are to be bevelled to ſuit their rake, muſt be evident by inſpecting the figure,

figure, and is generally known by all workmen, and therefore it is unneceſſary to dwell further upon it.

Prob. XXVI. Fig. 33. Plate V.

To find the Lines for working the Mouldings of a Clock Bracket, &c. when the front moulding projects more than the ends.

Operation.—Let *a o b d* be the plan of the clock bracket. From the center of *a o* draw the mitre lines to *b* and *d*, and from the center let fall a perpendicular, as at *f*. From this perpendicular draw a profile of the cavetto and aſtragal, according to the projection intended for the ends of the bracket. From the ſpring of the cavetto on the top of the necking raiſe a perpendicular up to the line *a o*; then from the upper part of the cavetto, as from 1, raiſe another perpendicular up to 1 on *a o*. From where theſe perpendiculars interſect with the mitre line, divide the intermediate ſpace into any number of equal parts, as at 1, 2, 3, 4. From theſe numbers on the mitre line draw perpendiculars up to the correſpondent figures on *a o*, and continue them downwards till they touch the cavetto at 2, 3, 4. Laſtly, draw from the utmoſt projection of the aſtragal or necking, a perpendicular, cutting the mitre line at 5; then from 5, 4, 3, 2, 1 on the cavetto draw parallels out at

pleaſure. Take in your compaſſes *d o* from the plan of the bracket, and place it from *d* to *p*, No. 1. From *p* let fall a perpendicular; then from the plan, as before, take 1.1 and place it from 1 on the perpendicular line *p* to 1 on the parallel line. Again, take the line 2.2 from the plan, and place it on the parallel line 2 to 2, and ſo of all the reſt, forming ſo many points, by which a profile of the front cavetto may be formed, and which will mitre in with the end cavetto, if the mouldings are exactly worked to theſe profiles, and the mitres be accurately cut. How the mitres are to be cut is eaſily ſeen by the mitre lines on the plan.

In Plate II. Fig. 12, an example of the ſame kind is ſhewn, as it may be performed by the Sector.

Let the quadrant A D be conſidered as one of the cavettoes to be mitred together. Then let it be propoſed that another cavetto is to mitre to the former, whoſe projection ſhall be equal to 1.10. Proceed then to draw this cavetto by the ſame directions as are given in page 39 for drawing an Oval; after which the cavettoes are to be worked according to theſe curves. The length of the mitre for the leaſt projecting cavetto is from 90 to 10, and that of the largeſt projecting cavetto is from 10 to A, and the mitre line is 9.10.

By

By theſe methods it is evident, that any moulding of different projections, and conſiſting of various members, may be worked, and cut ſo as to mitre exactly together.

Prob. XXVII. Fig. 34. Plate V.

Of working and mitring raking Mouldings.

Let No. 1, Fig. 34, be a level ovolo in a broken pediment. Make its projection equal to its height. Divide the height of the ovolo into any number of equal parts, and from theſe diviſions draw parallel lines, as is ſhewn in the figure. Next, from the extreme points of the ovolo draw two parallel lines, according to the rake of the pediment deſcribed below, which will of courſe increaſe the height of the ovolo. Draw then a perpendicular or ſquare line from either of the raking lines, as at No. 2. Divide this ſquare line into the ſame number of equal parts, and from theſe diviſions draw lines parallel to the raking part. Take then 5.5 from No. 1, and transfer this opening of the compaſſes to 5.5 on No. 2, and make a pencil mark where it extends to. Again, take in your compaſſes 4.4, from No. 1, and transfer this alſo to 4.4 on No. 2, and mark it as before; proceeding in the ſame manner with the reſt; by which points will be found to enable us to draw the raking ovolo ſo that it will mitre with the level one at No. 1. Laſtly, if a pediment

be

be open, then it will require returning mouldings to mitre in with the raking mouldings in front; for which returning members there muſt be another drawing made, as No. 3. The fillets, &c. of theſe returning mouldings ought to hang perpendicular with the level cornice; therefore draw, at No. 3, a line perpendicular with the level cornice. Raiſe then another perpendicular at a diſtance from that which was firſt drawn, equal to the projection of the level ovolo, as is ſhewn by the dotted line in No. 3 of Fig. 35; and from the point where this perpendicular cuts the raking line, draw a line parallel with the level cornice, which gives the whole breadth of the returning moulding, as is apparent by inſpection.

Divide the whole breadth of the returning ovolo into the ſame number of equal parts as before, and proceed exactly in the ſame manner to find the curvature of the returning ovolo as was done to find that of the raking one, and the whole by theſe methods may be completed.

In the ſame manner may be found the raking and returning cyma-recta mouldings, deſcribed in Fig. 35, which it is unneceſſary to ſay any thing about, after what has been ſaid on the ovolo.

PROB.

PROB. XXVIII. FIG. 36. Plate V.

As I have in this Section deſcribed the methods of drawing and mitring mouldings of different projections, and alſo of drawing and mitring raking with level mouldings, it may be proper here to deſcribe the proportion of the Tuſcan raking Pediment, and the manner of drawing it.

It is true, according to an orderly arrangement, the Pediment ſhould come after the column; but this is of ſmall conſequence, if it can as well be underſtood in this place.

The intention of a cloſe pediment, whether raking or circular, is not only to ornament the front door or entrance of any building, but likewiſe to ſhelter ſuch as ſeek admittance from inclement weather. For this purpoſe the raking cloſe pediment of any order is beſt calculated; for whilſt we are ſheltered from rain or ſnow by the bold projections of the ſeveral members of each order, eſpecially the Doric, the deſcending ſhowers eaſily and quickly glide off on each ſide, on account of the rake of ſuch pediments.

It is therefore improper to have open pediments of any order at the exterior entrances of buildings: and it is con-

ſidered

ſidered by architects as improper to have cloſe ones over interior entrances or door ways, where they are only employed as ornamental.

The pitch of the Tuſcan pediment is the ſame with the other orders, for in this reſpect they are all uniformly the ſame; but their intercolumniations, or ſpaces between the pillars or pilaſters, together with other particulars, vary according to the reſpective order to which they belong; which I ſhall mention afterwards, in treating on the Orders.

To proportion and draw the Tuſcan order, proceed thus:

Obſerve, that Fig. 36 is exactly half the pediment only; and therefore, in drawing a whole pediment, the diviſions ſpecified in the figure muſt be laid on each way from the central line. And obſerve likewiſe, that the frieze and architrave are not drawn to the cornice, becauſe they are not wanted in deſcribing the pediment.

Operation.—Lay down three diameters from the center of the pediment to the center of the ſhaft, as at 1, 2, 3, in the figure. Divide a diameter into eight equal parts, and take three of theſe and place them each way from the center line of the ſhaft, which gives the upper diameter of the column, as

the

the figure ſhews. Again, divide a diameter into four, as that diſtinguiſhed by the writing in the figure, and take three of thoſe parts for the perpendicular height of the cornice: at this height draw a parallel line at pleaſure ſufficient for the whole length of the pediment, as the upper line with the numbers. Then take the perpendicular height of the cornice, and place it from the outſide line of the ſhaft on the line continued out from the under edge of the cornice, which will determine its projection, as is eaſily ſeen by the level ſcale line *b*. Raiſe a perpendicular line from the whole projection, as *g*, till it cut the upper parallel line; then will this line ſerve as a ſcale for the heights of each member in the cornice, the proportions of which are eaſily ſeen by the aliquot parts on the ſcales; but if not rightly underſtood, the reader may ſuſpend his judgment till the Tuſcan order is deſcribed.

Divide the upper parallel line, which is equal to one-half of the whole length, into nine equal parts, and give four of theſe for the pitch of the pediment, as the figures 1, 2, 3, 4, ſhew. Draw then a right line from 4 to the utmoſt projection of the level cornice, and proceed to draw each member of the level cornice, as the ſcale lines direct.

Note, The two upper lines, containing the nine diviſions, repreſent the upper fillet of the level cyma-recta.

The next thing to be done, is to proportion the members of the raking cornice by thoſe of the level one. To do this, draw a ſquare line from the pitch of the pediment, and continue it till it paſs through the level cornice. Take then the ſkew meaſurement of the lower fillet of the level cyma-recta, as *a b*, and transfer this to the raking cyma-recta downwards, from *a* to *b*. Again, take *b c* from the level corona, and tranſfer it from *b* to *c* for the raking corona. Laſtly, take *c d*, *e f* in the ſame manner, and transfer them one after another for the raking mouldings, as before; after which, draw lines through the ſeveral points parallel to the pitch or raking line, and the pediment will be completed for ſhading if required.

SECTION

SECTION VI.

Of the Names and Properties of various Geometrical Solids—Of finding curved Lines to anſwer the Sections of various irregular Figures—and of the Nature and Conſtruction of Hip and Elliptic Domes.

In Section III. page 43, I have there obſerved on uſeful geometrical ſuperficies, that to have ſome knowledge of their names and properties is certainly of advantage to every one, eſpecially to thoſe who are concerned with drawing or making pieces of work of the like figures.

With equal propriety the ſame may be affirmed of the uſeful geometrical ſolids, the knowledge of whoſe names and properties frequently enable us to communicate our ideas of the figures of various objects that occur to us, with greater preciſion and freedom than we otherwiſe ſhould be able to do, were we, for want of this knowledge, obliged to uſe a number of explanatory words and ſigns before we could be underſtood.

 However,

However, I have not introduced more of theſe than what I think quite neceſſary to be known, and which I ſhall now endeavour to explain in as ſhort and clear a manner as I am able.

Of the Names and Properties of the General Solids.

In Plate VI. No. 1 is termed a Cube, which is a regular ſolid, bounded by ſix equal geometrical ſquares or ſurfaces, from Κυβος, *kubos*, a dye. It is alſo called by ſome a Hexaedron*, becauſe it has ſix ſeats or baſes on which it is capable of being reſted.

No. 2, is a Parallelopipedon, or Parallelopiped, a regular ſolid, contained under ſix parallelograms, whoſe oppoſite ſides are parallel and equal; or it is by ſome called a Priſm, whoſe baſe is a parallelogram.

If a piece of wood be ſeven or eight inches long, three broad, and two and a half in thickneſs, ſo planed that its ſides are all parallel, and cut ſo that its ends are ſquare to its ſides, then will the piece of wood be of the figure of a Parallelopiped.

* Hexaedron, from ἑξ, *hex*, ſix, and ἑδρα, *hedra*, a ſeat.

Of mitring a Comb Tray, or any thing of the same nature.

Fig. 32.

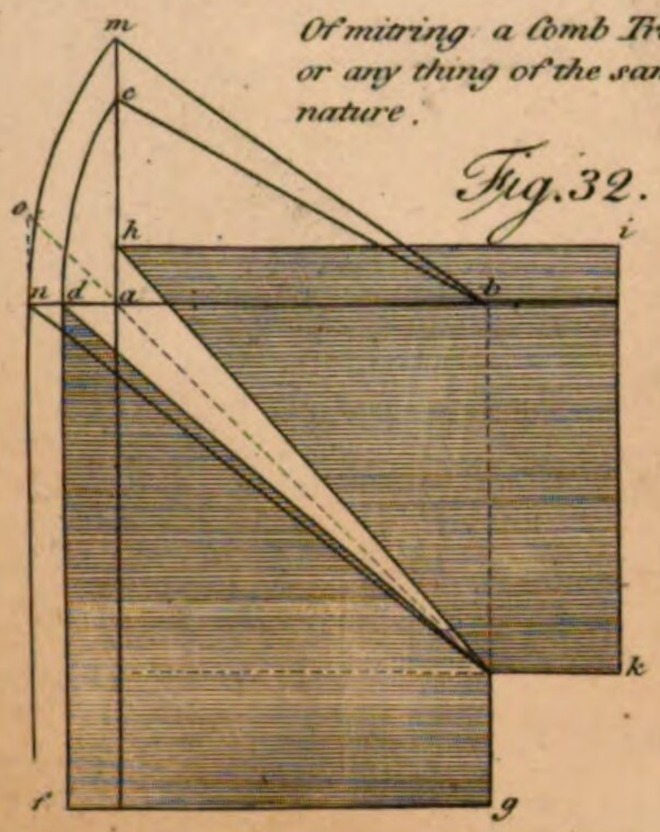


Fig. 33.

The method of finding the lines for working the mouldings of a Clock Bracket when the front moulding projects more than the ends.

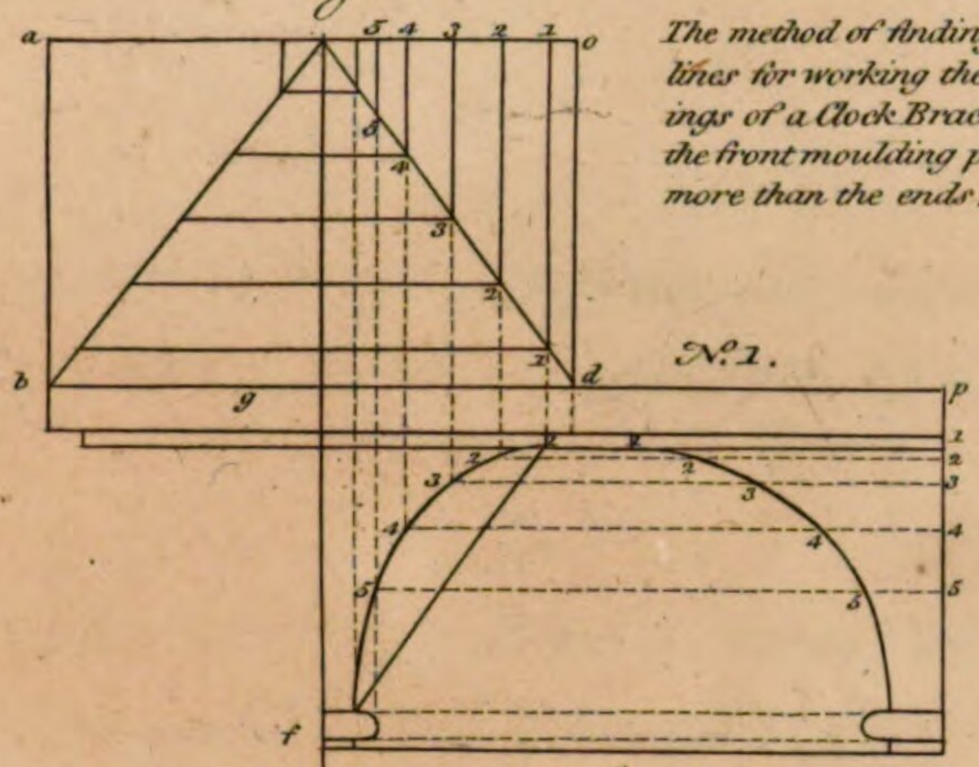


Fig. 34.

The method of working and mitring raking mouldings.

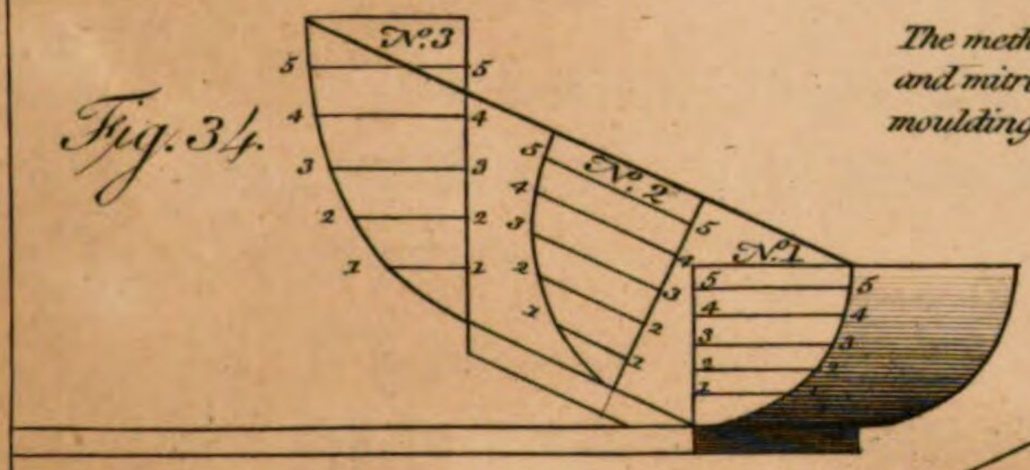
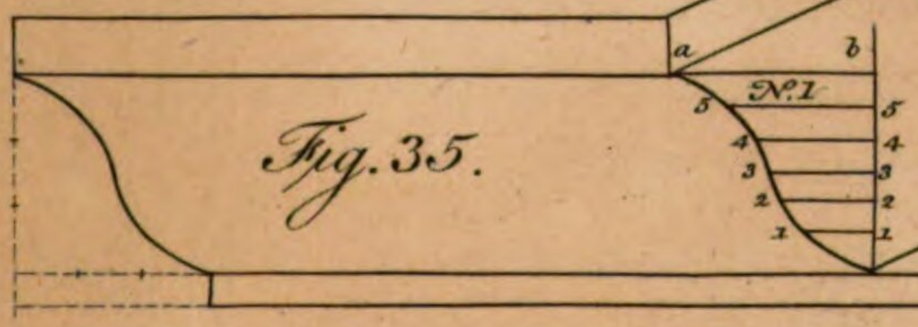
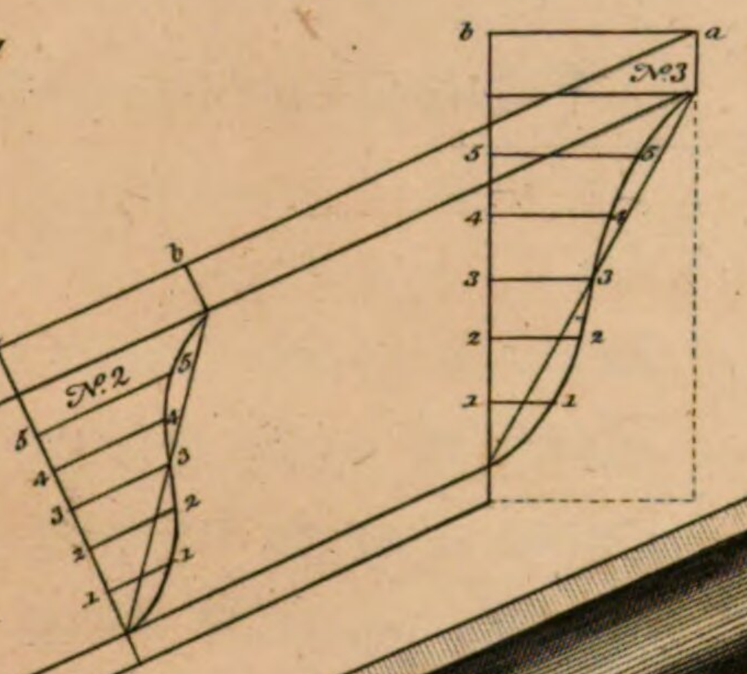


Fig. 35.





Half of the Tuscan Pediment

Fig. 36.

I Sheraton del.t

J Cooke sculp.t

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No. 3, is a Pentangular Priſm*, ſo called becauſe its ends are bounded by pentagons, or five-ſided ſurfaces, and its ſides by five parallelograms.

There are various kinds of Priſms; as No. 4, is an Hexangular; No. 5, a Trapezoidical; and No. 6, a Triangular Priſm.

An Hexangular Priſm is terminated at its ends by two ſix-ſided ſurfaces, and its ſides by ſix parallelograms.

If a piece of wood, ſeven or eight inches long, be rounded to two or three inches diameter, and if this piece of round wood be planed ſo as to have ſix ſides parallel to each other, then it will be of the figure of an Hexangular Priſm.

Again, a Trapezoidical Priſm is one which is bounded at its ends by two Trapezoids, (ſee No. 5, Plate II.) and whoſe ſides are four parallelograms, two of which are equal to each other, but not parallel, and two unequal in width, yet parallel.

If a piece of wood be ſeven or eight inches long, as before, and if one of its ſides be about three inches broad, and two of them two inches and a half, inclining or beveling off alike

* Priſm, from πρισμα, "ſomething ſawn or cut off."

from

from the ſide which is three inches, reducing the fourth ſide to two inches broad, then will the piece of wood be of the figure of a Trapezoidical Priſm.

Laſtly, the Triangular Priſm is ſo called, becauſe its ends are bounded by triangles, or three-ſided ſuperficies, and its ſides by three parallelograms.

If, as before, a piece of wood be planed ſo as to have three ſides, ſuppoſe each two inches broad, and their angles parallel, it will then be of the figure of a Triangular Priſm.

No. 8, is a Tetrahedron*, called ſo becauſe it comprehends, and is bounded by four equilateral† triangles. It may alſo be conceived as a triangular pyramid of four equal faces.

Hence, if a piece of wood be firſt cut into the form of an equilateral triangular priſm, and then be terminated from its baſe till the three ſides meet in a point perpendicular to the center of the baſe, and if the terminated or inclined ſides be equal in length to their baſe, then will the wood exhibit the figure of the geometrical ſolid, termed a Tetrahedron.

* Tetrahedron, from τέτρα, *tetra*, four, and ἕδρα, as before.

† See Plate II.

No.

No. 7, is an Octahedron. It receives its name from the eight equal and equilateral triangles by which it is bounded. It may alſo be conceived as two quadrangular pyramids, joined together at their baſes.

If, therefore, a piece of wood be formed into an equal quadrangular priſm, and if this priſm be terminated from its center each way, till all the ſides come to a point perpendicular to the centers of the reſpective baſes of the pyramids ſuppoſed to be joined together, then will the piece of wood, thus cut, give the true figure of an Octahedron.

No. 15, is a Dodecahedron, a regular ſolid, bounded by twelve pentagons.

To form or conſtruct this regular ſolid, a piece of wood may firſt be turned round, and then planed into ten equal ſides. Draw then a regular pentagon (Plate II. Fig. 19) on each end of the piece of wood, one of whoſe ſides ſhall be equal to one of the ſides which the wood was firſt planed to. Laſtly, make five faces on each end of the wood, which ſhall comprehend two of the firſt-mentioned ten ſides, and one of the ſides of the regular pentagon drawn on each end; then will the piece of wood form the figure of a Dodecahedron, as required.

No. 16, is an Icoſahedron, which is a regular ſolid, compoſed of twenty equilateral triangles. See Plate II. Fig. 7.

This figure may be conſidered as conſiſting of twenty triangular pyramids, as No. 8, whoſe vertexes meet in the center of a ſphere, imagined to circumſcribe it, and therefore muſt all have their heights and baſes equal.

To conſtruct this ſolid, a piece of wood ſhould firſt be made round, and then planed into ſix equal ſides. Upon each ſide draw an equilateral triangle, and the ſpaces between each triangle muſt be cut away to the ſide of the triangle thus drawn, and when this is done, there will then be four more planes or faces for four more equilateral triangles, which will make ten. Find the center of one end of the piece of wood, and terminate each ſide of the hexagon to this center, and there will be produced ſix more equilateral triangles, which added to the other, make ſixteen. Find the center of the other end, and terminate the before-mentioned four ſides to this center, and other four equilateral triangles will be produced, which will complete the twenty as required.

From what has been ſaid, it is evident that five of theſe ſolids are regular, ſince they may each of them be inſcribed within a ſphere, ſo that each angle ſhall touch the circumſcribing

ſcribing ſphere in ſome point. Hence, to form theſe regular ſolids, namely, the Cube, Octahedron, Tetrahedron, Dodecahedron, and the Icoſahedron, it is preſuppoſed in the above conſtructions, that the pieces of wood mentioned are all cubes, whoſe ſides are equal to the dimenſion of each figure.

No. 13, is a Pyramid, a ſolid, whoſe ſides riſe from a geometrical ſquare as its baſe, and terminate in a vertical point.

As the height of this ſolid is at pleaſure, its ſides are ſometimes bounded by equilateral triangles, and ſometimes by iſoſceles, as the figure referred to.

Nor are we to confine our ideas of Pyramids to ſuch only as have ſquare baſes, for theſe may be either triangular or polygonal, while yet their reſpective ſides ſhall terminate in a point perpendicular to the center of their baſes.

The learned are divided in their opinions about the derivation of the term Pyramid: ſome think the name is from πυρ, *pur*, fire, becauſe Pyramids aſcend to a point like fire; but others more confidently affirm, that it is from πυρος, wheat, or corn. "Not," ſays the author of this laſt opinion, "that we are to ſuppoſe that the Pyramids were ever intended for granaries; but that the Greeks, when, after many generations,

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they viſited Egypt, and ſaw thoſe amazing ſtructures, looked on them as ſtore-houſes for grain; and knowing Egypt to be a country fruitful in corn, they called them Pyramids—corn ſtore buildings; being, as they thought, the repoſitories for all the produce of Egypt."

No. 9, is a Cylinder. This is a ſolid, bounded by two equal circles at its ends, and a parallelogram revolving round their circumference. This figure is fitly repreſented by a garden roller, whence its name κυλενδρος, *kulendros*, a roller; and as for its conſtruction, it is ſo ſimple that it is unneceſſary to ſay any thing about it.

No. 12, is a Cone; a ſolid, bounded by two ſuperficies, one of which is convex, and the other ſtraight.

The baſe of a Cone is ſometimes an ellipſis, and ſometimes a circle terminating to a point perpendicular to its center. From this center to its vertical point, a line is ſuppoſed to paſs, called its axis, on which this body might be made to revolve. And the ſame may be obſerved of the Cylinder, Conoid, and Sphere, each of which has its imaginary axis, or right line, paſſing through its center, about which they may be made to turn.

No.

No. 14, is a Conoid; a ſolid, which terminates from its baſe to its vertical point in a curved or elliptic direction. Sometimes the curve of its ſide is hyperbolic, and ſometimes parabolic. See Plate II. Fig. 35, 36.

Its baſe, like the Cone, is either an ellipſis or circle.

No. 10, is a Hemiſphere*, which is one-half of a globe cut by a plane paſſing through its center, and therefore is contained under two ſuperficies.

No. 11, is a Sphere, or whole globe, which is a body or ſolid, bounded by one convex ſurface, whoſe parts are all at the ſame diſtance from the central point, as the perifery of a circle is to its center.

Of the Sections and Coverings of regular and irregular Figures; and how to find curved Lines to anſwer their various Sections.

The Section† of any ſolid is, when it is ſuppoſed to be cut by any plane paſſing in ſome direction through it, which,

* Hemiſphere, from σφαιρα, *ſphaira*, a globe or ſphere, and ημισυς, *hemiſus*, half, i. e. half a globe.

† Section, a cutting or dividing; "from *ſeco*, to cut."

of courſe produces a ſurface or ſuperficies conſonant to the nature of the ſection, and agreeable to the ſhape of the ſolid which is cut.

Hence, if a cylinder be cut oblique to its baſe, this ſection will produce a ſurface perfectly elliptic; and if a cone, Fig. 12, Plate VI. have a ſection parallel to its axis, the curved boundaries of the ſuperficies will be hyperbolic. See page 52.

" If a ſphere be cut in any manner, the plane of the ſection will be a circle, whoſe center is in the diameter of the ſphere."

But if two plains, or ſtraight ſurfaces, cut each other, their common ſection is a right line.

I mention theſe particulars, that the reader may more readily and clearly underſtand the following Problems.

PROB. XXIX. FIG. 32. Plate VI.

Let Fig. 32, Plate VI. be conſidered a ſolid, of the ſhape of a vaſe, whoſe covering and ſection are to be found; or, in other words, if a vaſe is required to be veneered, how to cut the veneer ſo as each joint ſhall appear ſtraight when the veneer is laid.

Operation.

Operation.—Draw the ſhape of the vaſe, which, in this caſe, is a ſemi-ellipſis on the conjugate diameter. Draw a perpendicular line through the center of the vaſe, which will be the long diameter. Divide this diameter into a number of equal parts, and on theſe diviſions draw lines parallel to the conjugate diameter, as the figure ſhews at 1, 2, 3, 4, &c. Draw then on each of theſe right lines a ſemicircle, and, for the ſake of greater accuracy, let the eighth ſpace be ſubdivided, by which another circle will be obtained near the center, as at 9. Draw next a perpendicular line at pleaſure, as at No. 1. Proceed then to take the dimenſions of the curvature of the vaſe thus: Place one foot of the compaſſes on 10, and extend the other to 9, and with the ſame opening of the compaſs fix one foot on 10, in No. 1, and ſweep the arch 9 at pleaſure. Again, fix the compaſs foot on 9, and extend the other to 8 on the vaſe, which transfer from 9 to 8 at No. 1, and opening the compaſſes, fix one foot on 10, and with the other ſweep the arch 8 at pleaſure. In this manner proceed with all the other diviſions on the vaſe, until its whole curvature is laid down on the perpendicular line at No. 1.

After proceeding thus far, it muſt then be conſidered how many pieces of veneer will cover the circumference of the vaſe, and how broad the veneers may be laid; which in this example I have ſuppoſed to be fourteen. Divide therefore each ſemicircle

into

into ſeven, as ſpecified by the ſmall dots on each arch. Upon the ſemicircle 9 of the vaſe, place one foot of the compaſſes on 9, and extend the other to the perpendicular line, which will be half the breadth of the veneer, according to the number of pieces propoſed. Take this opening of the compaſſes and place it each way from the perpendicular line at No. 1 on the arch 9. Again, on the ſemicircle 8, take the ſpace from the perpendicular line to 8, and transfer this to the arch 8 at No. 1, placing it each way from the perpendicular as before. In this manner proceed with the reſt, by which the proper breadth of the veneer on each ſemicircle will be determined; and if a regular curve line be drawn through each point on the ſeveral arches at No. 1, the curved boundaries of theſe arches will be the exact ſhape of the veneers, which, when properly laid down, will then have the appearance of ſo many ſtraight joints. And hence, by whatever rule or method we find the coverings of ſolids, regular or irregular, by the ſame rule we alſo find curved lines to anſwer their perpendicular ſections; for it is evident, if the vaſe, after being veneered, was cut through its center perpendicularly, and the veneer raiſed up again, that its edge would be a faint curve, like that at No. 1.

PROB.

PROB. XXX. FIG. 33. Plate VI.

To find the covering and perpendicular Section of a Solid partly convex and partly concave.

Operation.—Draw the profile of the ſolid propoſed, as Fig. 33. Let fall a perpendicular from the center of the top. Draw a line from 11 on the profile parallel with the top, and divide the aforeſaid perpendicular line into any number of equal parts, which in this example is ten. Draw parallel lines through each of thoſe diviſions, and on theſe lines draw ſo many ſemicircles, whoſe diameters ſhall be equal to the length of each line. Draw a perpendicular at pleaſure, as at No. 1. Fix one foot of the compaſſes at 1 on the profile, and extend the other to 2. With this opening fix one foot at 1, No. 1, and ſweep the arch 2. From 2 on the profile, extend the compaſſes to 3, and transfer this from 2 to 3 at No. 1. Then opening the compaſſes, fix one foot at 1, and ſweep the arch 3 at No. 1, and ſo on of all the other; by which the dimenſions of the curvature of the profile will be obtained.

Laſtly, take half the whole ſpace from 11 on the ſemicircle to the perpendicular line ſpecified by the dot, and place this opening of the compaſſes each way from the perpendicular line on the arch 11 at No. 1, and mark the places with a pencil.

Proceed

Proceed to 10 on the ſemicircle 10, and take half of its whole ſpace, and place it each way from the perpendicular on the arch 10 at No. 1, as was done on the arch 11 before; and in this manner go through the whole, and a ſufficient number of points will be found in order to draw an irregular curve anſwerable to a perpendicular ſection of the propoſed ſolid, and which will alſo anſwer for its covering or veneering.

But here I muſt obſerve to the workman, that in caſe it ſhould be propoſed to him to veneer any thing of the like forms of Fig. 32 and 33, it would not do to cut out the veneers ſo broad that fourteen pieces would be equal to the circumference. It would require twenty-eight pieces at leaſt, before they could be laid down with ſafety and eaſe, eſpecially if it were required that the joints of the veneers ſhould be ſo cloſe as to preclude the neceſſity of putting in ſtringing to hide them. I ſpeak this not merely from theory, but practice, having myſelf veneered knife-caſes of the ſame ſhape with the figures in the Plate, and where no ſtringing was admiſſible to hide the joints. But every thinking workman will eaſily perceive that it makes no difference in the methods of finding the curve lines for the covering, whether the number of pieces be fourteen or twenty-eight.

By theſe methods a ſphere or globe may be covered, and a

curve,

curve, anſwerable to any ſection, through its center may be found. I have not given any example of this on the Plate, as it is preſumed that a few hints will ſerve, after what has already been ſaid on the ſubject.

Operation.—Draw a circle whoſe diameter ſhall be equal to the axis of the ſphere to be covered. Divide the ſemi-diameter into nine equal parts, and on theſe parts draw lines acroſs at right angles with the diameter, till they touch the circumference of the circle on each ſide. From theſe ſeveral lines draw ſemicircles, as was done before in Fig. 32 and 33. Divide the ſeveral ſemicircles into eighteen degrees each, and take one degree from the largeſt ſemicircle, and place this opening of the compaſſes on a right line eighteen times. Then from the extreme points on this line draw arches each way, till they meet in the center of the line. Laſtly, transfer half a degree from each ſemicircle to their correſpondent arch, laid on each way from the right line, as was done on No. 1, Fig. 32; and the whole thus transferred, a curve line paſſing through each half degree laid on the ſeveral arches both right and left from the center line, will form the proper covering for the ſphere or globe as required.

Obſerve, the covering will be of the figure of two ſegments of a circle joined together, and the length of the cover-

ing will be equal to half the circumference of the propoſed ſphere.

I muſt here entreat leave to remark, that notwithſtanding the above directions are addreſſed to men in the wooden way, yet it is certain that the Upholſterer may avail himſelf from what has been ſaid on the ſubject: for the coverings of the like ſolids made of any kind of ſtuff, ought to be cut by the ſame methods, and ſewed together in ſeams anſwerable to the joints in wood: but the elaſticity or pliableneſs of ſtuffs, &c. makes it unneceſſary to cut them into ſuch ſmall pieces as is abſolutely required in wood.

Prob. XXXI. Fig. 34. Plate VI.

To find the Section and Covering of a Knife-caſe whoſe front is a double oge.

Draw half the plan of the front, as Fig. 34, and divide the ſweep of the front into ten equal parts, as the figure ſhews. Next determine how much rake the knife-caſe is to have from back to front, by which it will be eaſily ſeen how much the ſwell of the front falls at that rate, as the diagonal line 10.1 ſhews in the caſe before us. Draw from 10 of the diagonal line a perpendicular at pleaſure. From the ſeveral

diviſions

diviſions on the curve of the front draw parallel lines, till they cut at the numbers on the aforeſaid perpendicular. Obſerve, that the numbers on the perpendicular line are placed to anſwer the parallel lines as they proceed from each number marked on the curve of the front. Every thing being now prepared for finding the covering and ſection of the knife-caſe, proceed to No. 1, and draw a right line at pleaſure, as 1.11. Take from 11 to 10, or any other of the diviſions, on the front of the knife-caſe, and with the compaſſes repeat it nine times on the right line 1.11 at No. 1. Then obſerve, that from 2 to 1 on the front of the knife-caſe is rather a wider ſpace than the other diviſions, which are all equal. The intention of this is, to bring the parallel line, which proceeds from 2 on the front, a little farther on from the front line 1.1; therefore take from 2 to 1 on the front, and place it from 2 to 1 on the right line at No. 1, then will the whole length from 1 to 11 at No. 1 be equal to the whole curvature of the front of the knife-caſe, ſuppoſed to be ſtretched out in a right line. On the ſeveral diviſions on the right line 1.11, at No. 1, draw perpendicular lines at pleaſure. Take in the compaſs the ſpace 1.1 from Fig. 34, and transfer this opening to the perpendicular line 1 *c* at No. 1, marking it with a pencil. Then again take the ſpace from 2 to the diagonal line at Fig. 34, and transfer this to the perpendicular line 2 at No. 1, and mark it with a pencil as before. Do the ſame from the lines 3, 4, 5, 6, 7, at Fig. 34, and

obſerve that 11 follows 7, becauſe it proceeds from the point 11 on the front of the caſe; therefore take the ſpace from 11 on the perpendicular line to where the parallel cuts the diagonal, and place it on the perpendicular at No. 1. Likewiſe take 8 and 10 in the ſame manner. As for 9, it is loſt, becauſe that diviſion on the front of the knife-caſe falls on the right line, and, of courſe, has no projection. Laſtly, through all the points on each perpendicular at No. 1, draw a curve line, which will anſwer to the ſection of the knife-caſe, if it be cut anſwerable to the bevel line 10.1 on the plan of the caſe.

The dark ſhade *e a b*, at No. 1, ſhews half the veneer or covering of the knife-caſe; and if a piece of ſtrong paper be cut double, according to the boundaries of the dark ſhade, it will ſerve as a pattern to cut the knife-caſe open by, and likewiſe to cut the veneer by, before it is glued down. The inſide veneer for the front of the top may alſo be cut near enough by it, though it will vary a little; but this defect is not equal to the advantage of having the inſide veneer pretty nearly cut to the ſweep, becauſe it will then glue down much eaſier, and be leſs liable to ſplit.

From what has been ſaid on this Problem, the ingenious workman may apply the rules and obſervations to other purpoſes that may be of more importance than the cutting and

veneering

Various Geometrical Solids and their Names

Cube
1

Parallelopipedon
2

Pentangular Prism
3

Hexangular Prism
4

Trapezium Prism
5

Triangular Prism
6

Octahedron
7

Tetrahedron
8

Cylinder
9

Hemisphere
10

Cone
12

Pyramid
13

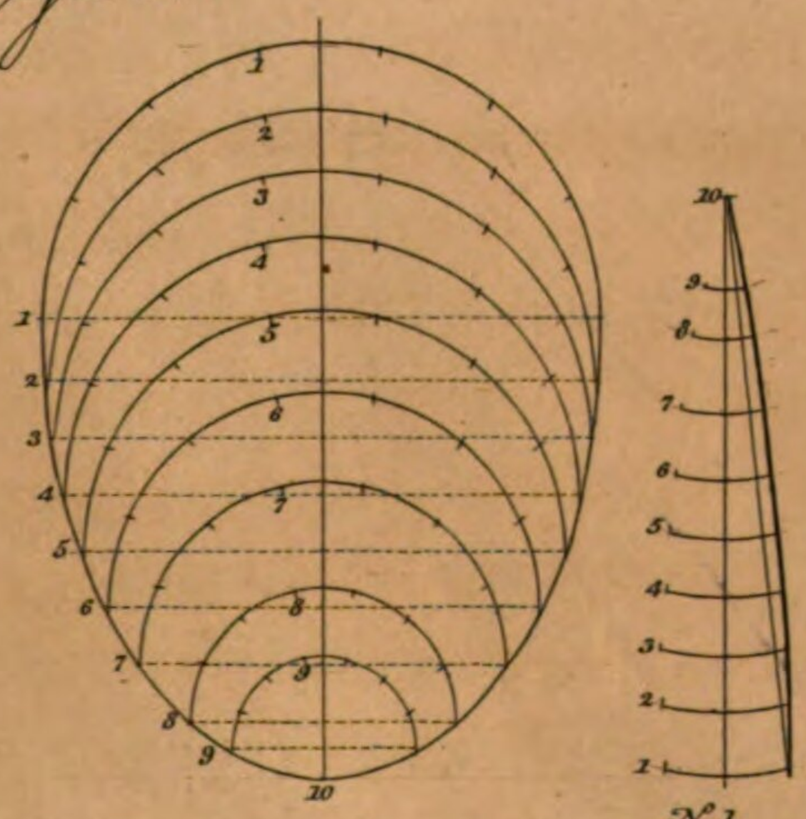
Conoid
14

Dodecahedron
15

Sphere
11

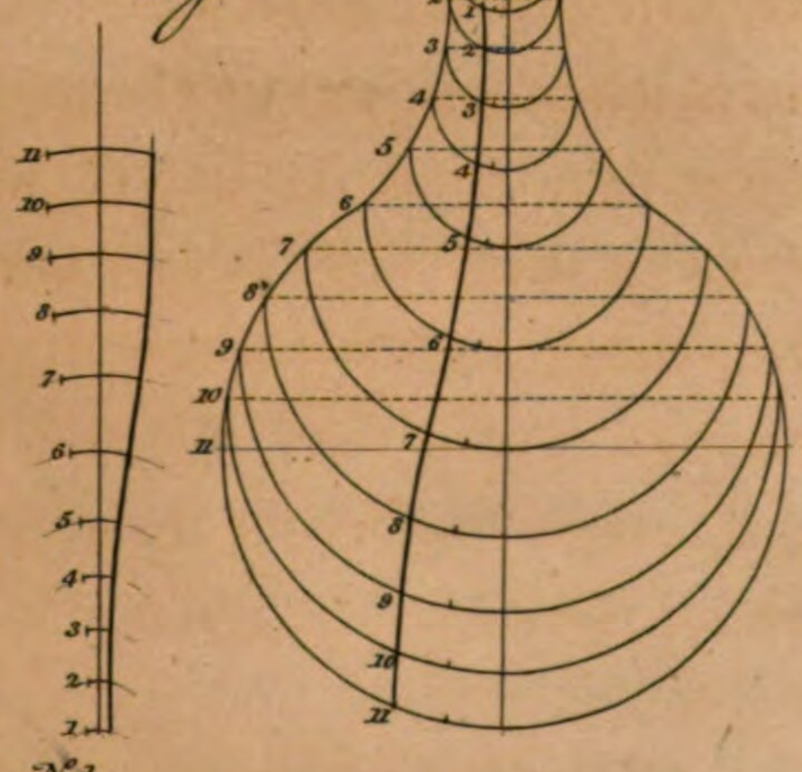
Icosahedron
16

Fig. 32.



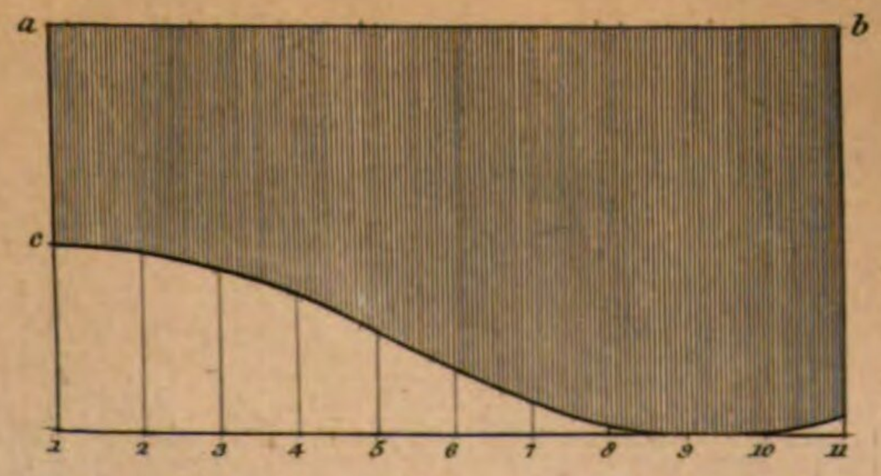
N.º 1.

Fig. 33.

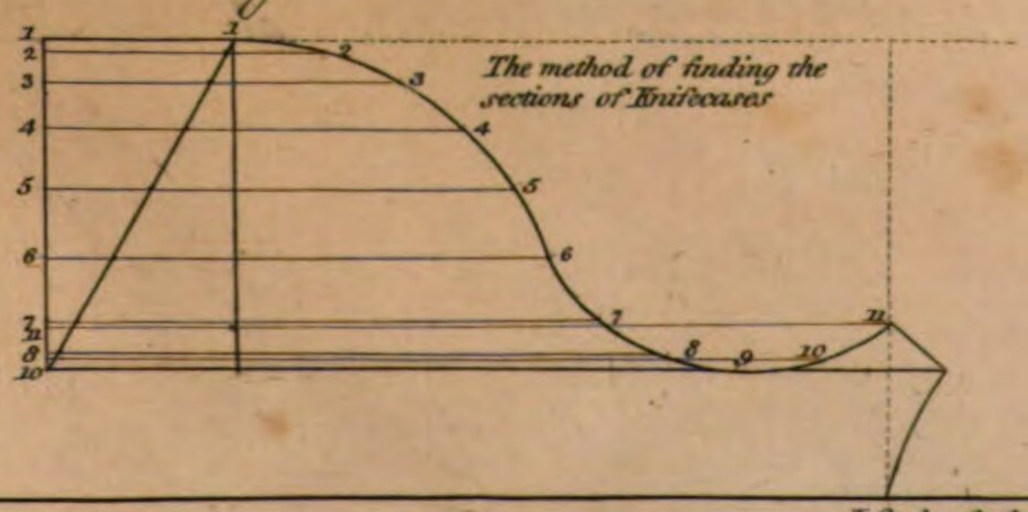


N.º 1.

Fig. 34.



N.º 1.



T. Sheraton del.t

J. Cooke Sculp.t

Pub.d as the Act directs Sept.r 30. 1791 by T. Sheraton.

veneering of a knife-caſe, which I muſt leave him to do as neceſſity may require.

Of the Nature and Conſtruction of Hip and Elliptic Domes for Beds.

Domes of various kinds have, for many ages paſt, been introduced into elegant and magnificent buildings, on account of their graceful effect and majeſtic appearance.

I am of opinion that the notion of employing domes for the roofs of grand buildings, was firſt ſuggeſted by the appearance of the hemiſphere ſurrounding our earth or horizon, forming a canopy or roof to the globe; which if it were ſo, domes had their origin from a truly ſublime and magnificent idea.

The uſe of domes for the tops of beds is of much later date than for buildings; but it is certain, whoever he was that firſt employed domes for the tops of beds, he muſt be conſidered as a perſon of enlarged ideas, as no other top or roof for a genteel bed can equal them: therefore we ſee them generally uſed for ſtate beds, where, it is certain, both grandeur and bold effect are eſſentially requiſite.

The

The term Dome generally implies a vaulted, arched, or ſpherical roof. Some derive it from *domus*, a houſe, and others from the barbarous Latin *doma*, a roof or open porch.

When an arched roof is raiſed from a ſquare or oblong plan, it is called an Hip Dome, becauſe they require mitre ribs at each angle, uniting in a center at top. But thoſe domes which take their riſe from an oval plan are called Elliptic; and, laſtly, thoſe which have an octagon or hexagon for their plan may be ſtyled Polygonal Domes.

PROB. XXXII. FIG. 35. Plate VII.

To conſtruct an Hip Dome.

Operation.—Let A B C D be the under teſter, upon which another teſter is to be fixed to receive the ribs of the dome. Draw the diagonals D B and A C, and their interſection will be the center for the dome. Draw a right line through the center parallel to A B; draw another line through the center at right angles with it, then will the diagonal lines be the plans of the hip ribs, and thoſe at right angles to each other will be the plans for the center ribs. Draw a circle from the center of the dome of about eight inches radius, as the figure ſhews, which is intended as a ground for ornament in the center of

the

the dome at the inſide, and alſo to combine together the hip and center ribs.

Proceed next to conſider the height of the dome as may be required. Let 7.6 at No. 1 be the perpendicular height of it, and let *m n* be the width of the dome. Then draw a ſemi-ellipſis to paſs through the points *m* 6 *n*. Divide half of this ſemi-ellipſis into as many equal parts as it may be thought neceſſary to have ribs in that ſpace, which in this example is ſix. Draw on theſe diviſions perpendicular lines, as the figure ſhews, and ſubdivide the laſt ſpace, from which raiſe a perpendicular as before.

Proceed to No. 2, and divide half the length of the dome, as *f o*, into the ſame number of equal parts as half the width was divided into. From the diviſions raiſe perpendiculars at pleaſure. Take the length of the ſeveral perpendiculars from No. 1, and place them on the correſponding perpendiculars at No. 2, and draw a curve line through each point; then will the ellipſis thus produced be the outſide ſhape of all the long ribs, the ſame as No. 1 is of the ſhort ribs. Laſtly, proceed to No. 3, which is for the four hip ribs. Draw the dotted lines from 8, 9, 10, 11, 12 at No. 1 till they cut the diagonal line *g h* at the correſponding numbers. From theſe interſections raiſe perpendiculars at pleaſure, as before. Transfer the length of each

perpendicular line from either No. 1 or 2 to No. 3 on each perpendicular as numbered, and drawing a curve line through each point as before, it will produce an ellipſis for the outſide ſhape of each hip rib.

The next thing to be conſidered, is the length required for each rib, according to their diſtance from each angle of the dome. A little thought will make this eaſily underſtood; for if No. 3 was placed in an upright poſition, being conſidered as a frame, and if the portion of the curve from *n* to 1 at No. 1 was placed upright to it, the two points 1 in No. 1, and 1 in No. 3, would coincide, and the point 2 of No. 1 would coincide with 2 at No. 3, and ſo of all the reſt. Hence, from *n* to 1 of No. 1 is the length of the firſt ſhort rib, whoſe plan is at *a*; from *n* to 2 is the ſecond ſhort rib, whoſe plan is at *b*; from *n* to 3 is the third ſhort rib; its plan at *c*: from *n* to 4 is the fourth ſhort rib; its plan at *d*: and from *n* to 5 is the fifth ſhort rib; its plan at *e*. The long ribs are taken from No. 2 in the ſame manner; each of which has its plan laid down at No. 3, as *a b c d e f*, ſo that I need not ſay any thing more on this part of the ſubject. For the length of the hip ribs, take from *p* to 5 at No. 3, and allow three-quarters of an inch for dovetailing into the center block.

General

General Obſervations on the Management of Hip Domes for State Beds.

Theſe kinds of domes ſhould be made in four parts, for the ſake of convenience in fixing up, or for more eaſy conveyance into the country. The center block ſhould therefore be made in four quarter parts, on account of the hip and center ribs which are fixed into it, that the four quarters of the dome may eaſily be ſeparated and put together again without injury. Domes in four parts muſt therefore have eight hip ribs, or two at each angle, mitring together, to which the ribs of each ſeparate quarter are fixed. For the footing of theſe ribs a ſham or upper teſter ſhould be formed, about three inches in breadth, which will give room beyond the ribs to ſcrew it to the under teſter.

When the four quarters of the dome are thus formed by ribs, a covering of thin deal, like Venetian ſhade ſtuff, ſhould be provided, and after covering both inſide and outſide of the dome, the deal may be ſized over with thin glue, to ſtrengthen it. After the ſize is dried, then good canvas may be glued or paſted on, both inſide and outſide of the dome, which will add to its ſtrength, and give ſmoothneſs to its ſurface. The outſide of the dome may then be painted, to match the furniture of the

bed, and the inſide is always lined with whatever kind of ſtuff the hangings are made of.

The inſide of the dome ſhould have neat gilt mouldings up the hips, both for ornament, and to hide the joint which is occaſioned by the mitring of the quarters together. And from the ſpring of the dome, or round the under teſter, ſhould be an ornamented architrave, which will receive and hide the lower end of the hip-mouldings, and will alſo cover the tacking of the inner valence, as well as contribute to the grandeur of the effect of the whole. To theſe ornaments ſhould be added a richly carved patera, fixed to the center block of the inſide of the dome, which will alſo receive and hide the upper ends of the hip-mouldings before mentioned. Laſtly, a ſtuffed head-board, in a gold frame, with foliage ornaments on the top of it, in imitation of a pediment, will add greatly to the effect of the whole, and harmonize with the other enrichments abſolutely neceſſary for a ſtate bed.

For the outſide ornaments of a bed of this kind, great care ſhould be taken to avoid every thing that would appear trifling. The pillars ſhould be maſſy as well as tall, ſuited to ſupport the dome, whilſt height gives room and effect to fine drapery. Sometimes the pillars are white and gold, and ſometimes all gold; or the ground of the ornaments may be of the colour of the ſilk, &c. of which the hangings are made. If emble-

matical ornaments are introduced in the cornice, or on the top of the dome, thoſe deſcriptive of unity, love, and innocency, ſhould be ſtudied; and thoſe of war, ſtrife, or other irregularities of the human paſſions, ſhould be avoided.

Noblemen's creſts may be introduced, as ſerving to diſtinguiſh the different branches of families; but, in my opinion, not as they relate to armory.

The height of a ſtate bed may be varied according to the different heights of rooms they are to ſtand in. However, they never ſhould be leſs than twelve feet to the top of the dome, including a vaſe. Nor ſhould they, in my opinion, exceed fifteen feet, not even where a room would admit of it. For then the ornaments of the cornice and dome would loſe their effect through diſtance, and the whole compoſition would appear as if loftineſs were the greateſt beauty.

The length of a ſtate bed may be ſeven, but ſometimes eight feet, when the area of a room is extenſive.

The width of theſe beds is in general about one foot ſhort of their length, but ſometimes they are made nearly ſquare.

The height of the frame, including the caſtors, is fourteen inches.

French caſtors are the beſt for the purpoſe, fixed upon a ſtrong iron plate, ſcrewed to the under edge of the ſides and ends, ſo that the caſtors may run clear of the pillars, and be detached from them, by which their riſe is hid from the eye.

Theſe are remarks made from my own experience in the buſineſs, which I offer for the aſſiſtance of the candid workmen of both branches; but the ſnarling critic may reject them if he pleaſe.

PROB. XXXIII. FIG. 36. Plate VII.

To conſtruct an Elliptical Dome.

Operation.—Let A B, D E be the plan of the teſter, whoſe inſide forms a true ellipſis by the help of angle pieces framed in, which muſt be evident to every workman.

The oval being thus formed according to the inſide length and breadth of the teſter, and the two diameters being already drawn, proceed with one quarter of the dome thus: draw the plan of the upper teſter, into which the ribs are to be fixed, as the ſecond elliptic line ſhows. Divide then the portion of the

ellipſis between *o* and *l* into as many equal parts as it is required to have ribs in one quarter of the dome, as at *o a h i j k l*, tending to the center *b*.

From theſe center lines draw parallel lines on each ſide, which ſhall determine the thickneſs of the ribs, and at the ſame time ſhow how broad each rib will be required, in order to give it its proper twiſt ſo as to ſuit the ellipſis; for here it muſt be obſerved, that every rib, excepting the one that is upon each ſemidiameter, muſt have a winding form, both inſide and outſide, in proportion to the length of the oval with its breadth.

Determine, next, how much the dome is to riſe from the teſter, which, in this example, I conſider to be equal to half the ſhort diameter; and therefore the arch of the rib B is a quadrant of a circle, drawn from the center *b*. This arch will ſerve for two ribs, that is, B and its oppoſite. Likewiſe, from the arch B, we determine the outline of every other rib thus: divide the ſemidiameter *a b* into five and an half equal parts, and raiſe perpendiculars till they touch the arch B. Divide the plan of the rib *a b* at No. 2 into the ſame number of equal parts, and raiſe perpendiculars at pleaſure; to which perpendiculars transfer the ſeveral lengths of thoſe at No. 1 to the correſponding ones at No. 2, as *a c d e f g*; by which the rib A will be formed. The ribs for *h i j* and *k* are formed in the

ſame

ſame manner, and therefore it is unneceſſary to deſcribe theſe.

Obſerve; C, on the plan of the elliptic teſter, is for the long center rib and its oppoſite, as will eaſily be underſtood by inſpecting the figures, and a little reflection on the ſubject.

Of the Management of Elliptical Domes.

Theſe domes may be made in four parts, the ſame as hip domes, if required.

The ribs of theſe domes are all dovetailed into a center block, which may be circular or elliptical to ſuit the dome, and which ſerves for the ground of a carved and gilt patera for the inſide of the dome, as has already been mentioned on hip domes.

When the ribs are all completely fixed, the ſpaces between them may be filled up by glewing white deal in; and when the pieces of deal are worked down to the ribs, the whole will form an agreeable dome, which ſhould be covered with canvaſs, and painted to ſuit the furniture, or otherwiſe covered with the ſame kind of ſtuff. And if ſo, it will be unneceſſary to cover it with canvaſs; but as the ſtuff muſt be put on the dome in ſo

many

The construction of Hip and Elliptic Domes

Plate. 7.

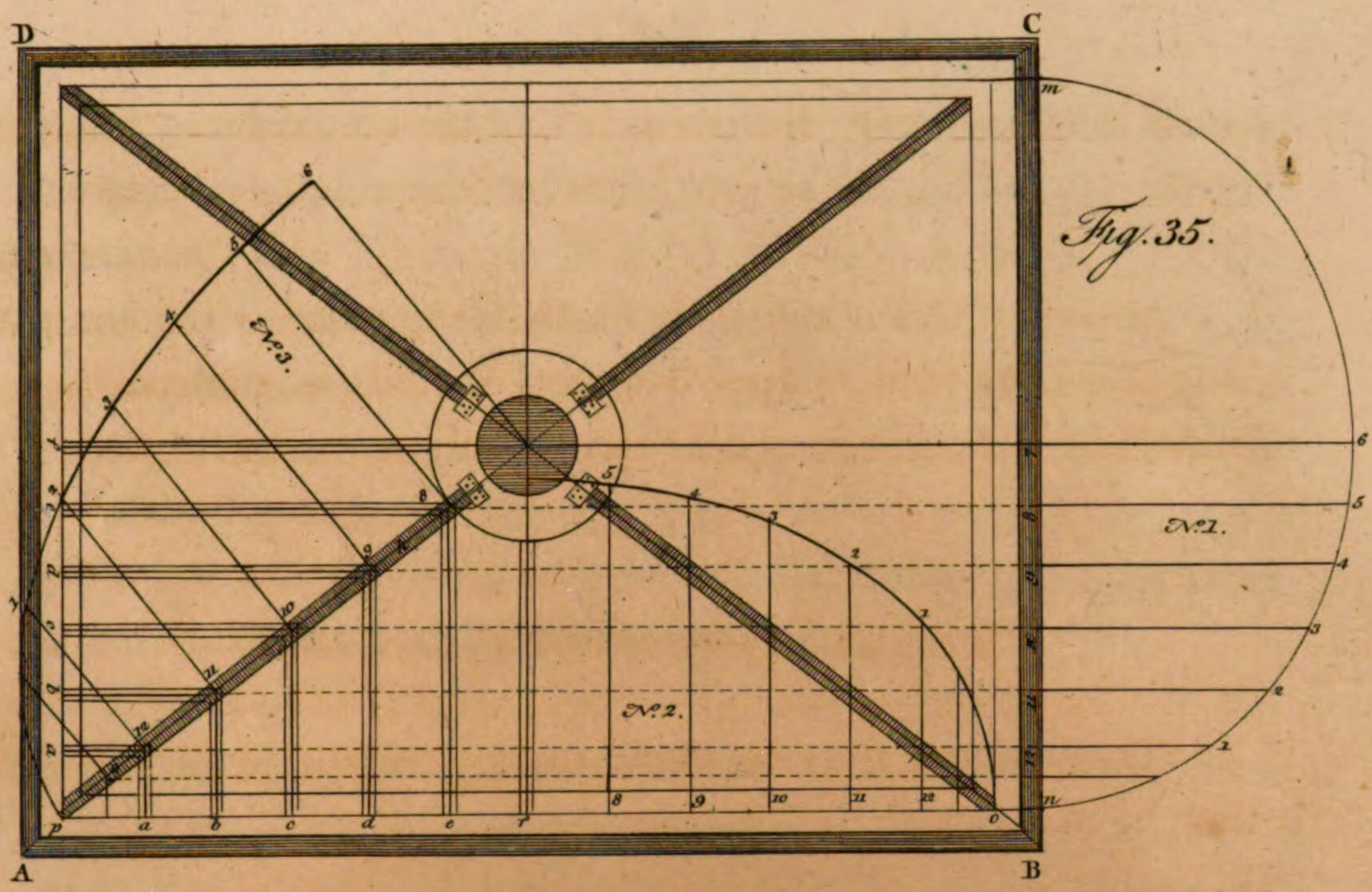


Fig. 35.

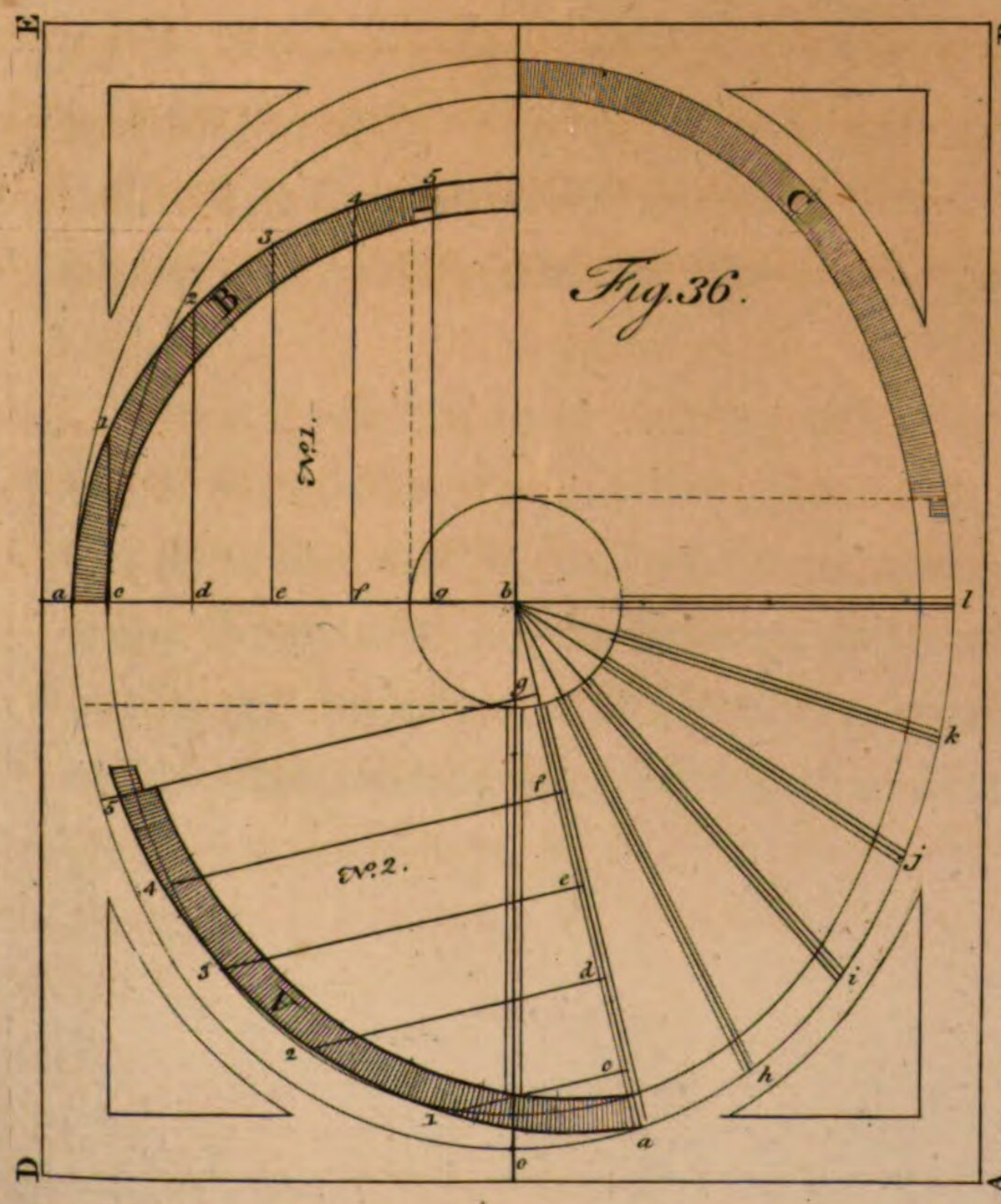


Fig. 36.

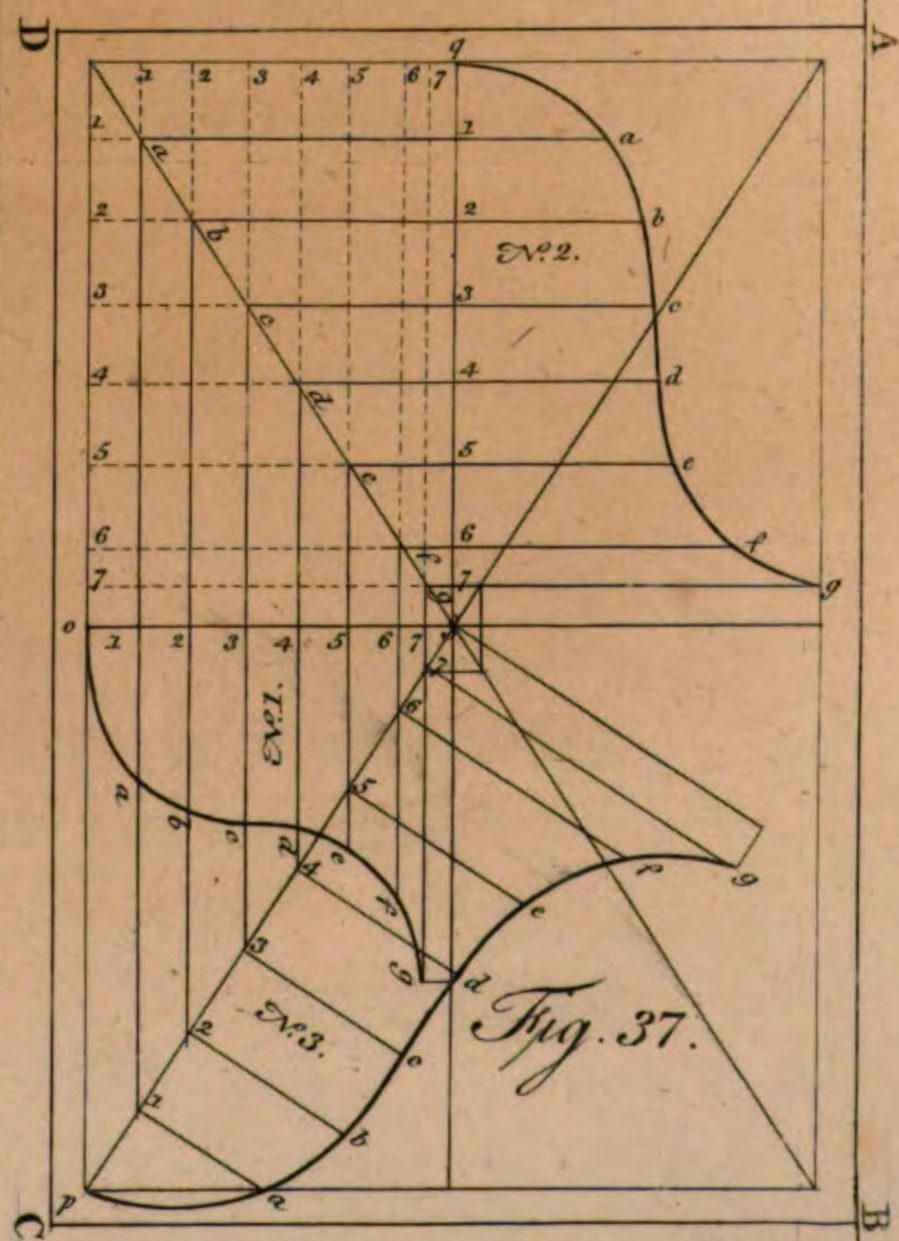


Fig. 37.

T. Sheraton del.t

J. Bolx Sculp.t

Pub.d as the Act directs Dec.r 10.th 1791 by T. Sheraton

many breadths, cut ſo as to anſwer its ſhape, a gimp may be ſtitched on to hide the tacks and give the dome a more rich appearance. But if the dome be large, it may have ſmall gilt moulding in place of the gimp, which are fixed to the dome by gilt-headed ſcrews.

For the inſide of the dome, it will be requiſite to have a gilt moulding, to hide the joining of the under and upper teſter, and to ſerve as an architrave to the dome.

The triangular compartments at each corner of the teſter, occaſioned by the manner of framing it to ſuit the dome, ſhould have ſmall mouldings put on to ſuit that ſhape, which will take off the flat and heavy appearance it would otherwiſe have, and add to the effect of the whole. As for any other particular with reſpect to ornaments, what has already been obſerved on hip-domes may alſo be applied here.

With reſpect to the dome deſcribed by Fig. 37, I do not think it neceſſary to go through an explanation of it after what has been ſaid on Fig. 35, which, if the reader has fully underſtood, he cannot fail to be acquainted with the lines laid down in Fig. 37, merely from inſpection, eſpecially as I have marked each correſponding line with ſimilar letters and numbers.

SECTION

SECTION VII.

Of the Proportion of the five Orders, adjuſted by Modules, Minutes, and aliquot Parts; together with ſome Account of their Antiquity and Origin. Alſo of the general Proportions of Frontiſpieces adapted to each Order.

INTRODUCTION.

I HAVE no doubt but it may be thought unneceſſary by ſome to introduce the orders of architecture into this work, after ſo many publications of this ſort by men of the firſt claſs in the profeſſion of this art.

To remove this objection and unfavourable impreſſion from the mind, I ſhall juſt mention two or three particulars which induced me to make the five orders a part of this Drawing-Book.

First.—In my opinion, and it is preſumed that I am not ſingular in this, nothing can appear more worthy of a place in a complete drawing-book than the five orders accurately laid down and neatly engraved; by which we ſee the proportions and effect of each moulding arranged and connected

nected together, according to the compoſitions of thoſe ancient architects of Greece and Rome, who are ſo juſtly famous in the world.

Beſides; from a Plate of the above kind, we are not only made acquainted with the proportions and ſhape of each moulding, but have likewiſe the advantage of ſeeing the effect of light and ſhadow produced by the ſun's rays falling in a certain direction on the ſeveral parts of a column.

The knowledge of theſe particulars muſt ever be conſidered as eſſential parts of good drawing, in which architecture is often introduced, and ſometimes makes the principal figure.

Second.—As many cabinet-makers, and even ſome ingenious upholſterers, are found deſirous of having a knowledge of the five orders, and the proportions of the ſeveral frontiſpieces, I thought an attempt of this ſort would be favourably received, as it undoubtedly tends to make the work more generally uſeful, and will prevent the trouble and expence of having recourſe to other books on the ſubject. And this has not been merely my own opinion, but the ſentiment of ſome well-wiſhers, who deſired me to let the orders have a place in my book.

Laſtly.—Beſides the reaſons juſt mentioned for publiſhing the five orders, I muſt frankly own myſelf a lover and admirer of thoſe ancient productions of ingenuity and art, which, in my opinion, cannot be much, if in the leaſt, improved by the force of modern genius.

If, therefore, the author conſiders himſelf as a kind of devotee or bigot to theſe remaining monuments of ancient ingenuity, ſurely he may be granted the liberty of paying the following ſmall tribute to the memory of thoſe great architects who had the honour of bringing the five orders to that perfection which we now ſee them in at this day.

And further, as I believe that the orders are now brought to ſuch perfection in their proportions, as will bear the ſtricteſt mathematical examination, I conſider them as incapable of improvement, except perhaps in ſome part of their ornament, and therefore they are claſſed with thoſe things in this book that will remain unalterable.

Of the Origin and Antiquity of the Order of Architecture.

Some diſtinction is to be regarded between the origin and antiquity of the orders, and that of architecture * in general.

The firſt ideas of architecture in general, may perhaps be traced from thoſe rude and irregular methods of building tents and huts which were the firſt habitations of man.

But in theſe ſtructures, nature and neceſſity were their only guides, unleſs they obtained ſome inſtructions or hints from the manner in which birds build their neſts, as Vitruvius conjectures.

We are informed by Moſes, that Jabal was the father of ſuch as dwelt in tents: and I ſuppoſe it is meant, that he was the firſt maker of them likewiſe. And I further imagine, that the city which Enoch built about that time was an aſſemblage of thoſe tents, perhaps ſurrounded by a mud wall, and ſo ob-

* Architecture implies the ſcience of building in general, which gives rules for deſigning and raiſing all kinds of ſtructures or edifices. It is from the word architect, compounded of αρχος, *archos*, the principle, and τεκτων, *tecton*, the chief artificer, or one who gives rules for, and directs the management of, buildings.

tained the name of a city in thoſe days; for it can ſcarcely be thought that they had at that time either diſcovered ſtone, or knew how to make brick, and much leſs how to put them together in houſes, ſo as to form a city according to thoſe mentioned in after times.

But, however, very early after the flood of Noah, we read of an attempt made to build a city and tower whoſe top was to reach the heavens. Their materials were then brick, and ſlime for mortar. And when we conſider how great their deſign was, and how ſucceſsfully they proceeded until the Divine Hand ſtopt them, we muſt neceſſarily infer, that men in theſe days began to know the rules of building, and of courſe this may be conſidered the origin of regular architecture.

But the origin of that part of architecture called the *five Orders*, is of much later date than this. They appear to me, and it has been the opinion of ſome great architects, that they owe their beginning to Solomon's Temple.

I do not mean that pillars or columns were never in uſe before this famous building was erected, but only that we do not read of certain proportions aſſigned to their height and diameter till thoſe given to Jachin and Boaz, the names of two pillars ſet up at the entrance of the porch of this building.

We

We read of pillars above four hundred years before the days of Solomon: and we read alſo, that theſe pillars had chapiters and fillets of gold and ſilver; but no mention is made of their height* or diameter; yet ſomething may be known as to the intercolumniation of theſe pillars, for there were twenty pillars ſtanding in an hundred cubits, the length of each ſide of the tabernacle. See Exod. xxxvi. 38. and xxxviii. 11. However, as there are no proportions aſſigned to theſe pillars, I preſume we cannot date the origin of the orders here; yet I think there would be more plauſibility in it than what ſome have advanced on this ſubject.

The pillars which Solomon erected at the entrance of the temple were of the following proportion, according to the language of the ſcriptures:—Their height was eighteen cubits, or twenty-ſeven feet without their chapiters or capitals; and their chapiters were five cubits; which in all makes thirty-four and an half feet in height. A line of twelve cubits did compaſs either of them about, conſequently their diameter was ſix feet; and had theſe pillars been one cubit higher, their proportion would have anſwered exactly to the original Doric † Order, whoſe height was equal to ſix of its diameters.

Beſides

* Joſephus indeed ſays, "Every pillar was five cubits in height;" and he ſpeaks alſo of five pillars at the entrance of the tabernacle, that were gilded, and ſtood on baſes of braſs.

† For ſome time after the firſt invention of this order, the proportion of its diameter to the

Beſides the likeneſs or affinity between the Doric column and thoſe ſet up by Solomon, will ſtill appear more ſtriking, if we conſider that the ancient Doric had no plinth or baſe; for does not appear to have been any at the foot of Jachin and Boaz, otherwiſe I think they would have been mentioned as well as the chapiters. But theſe columns are ſaid to have fillets, whoſe thickneſs was four fingers, and they were made hollow. See Jer. lii. 21.

Theſe fillets ſeem to anſwer well enough to the Doric necking at the top of the ſhaft. They were hollow, and of four fingers thickneſs or projection, which is nearly the ſame projection as would be required in the necking of a Doric column of the dimenſion of Jachin and Boaz.

There is another particular which may be mentioned which alſo bears ſome likeneſs to the Doric, and that is the ſize of the porch or entrance, on each ſide of which theſe maſſy pillars were placed.

This opening was twenty cubits in width, and forty in height, anſwering to the proportion of the Doric frontiſpiece or door.

the height was as the length of a man's foot is to the height of his whole body, which at that time was reckoned to be one ſixth part; but afterwards they added another diameter, and at length brought it to eight.

And laſtly.—The lily-work on the chapiters, and the rows of pomegranates round about the chapiters, were, in my opinion, as likely to have given riſe to the ancient Doric order, and more ſo than the manner of building ancient huts, by placing trunks of trees on each ſide, by which the roof was ſupported.

Yet I will not ſay but trunks of trees thus employed, might firſt give exiſtence to the notion of ſome kind of a pillar to be uſed in the firſt buildings of brick or ſtone, while, at the ſame time, I am inclined to think that columns were never reduced to any order till the building of Solomon's temple by God's appointment.

However, it is not to be underſtood as if the regular Doric order could be copied from Solomon's pillars, but only ſuch hints and proportions taken from them as ſerved in after times to compoſe the firſt order of architecture.

Nor can it be thought that the firſt compoſition of the Doric column had theſe triglyphs and mutules which we now ſee it has, till after it was reduced to its proper form and character. It is therefore thought to have been more ſimple and maſſy in its primitive ſtate; ſomething like the Tuſcan order. Some imagine,

imagine, and not without ground, that the Tuſcan, nearly as we have it now, was the firſt ſtate of the Doric.

Vitruvius ſpeaks of a ſtate in which the Doric column was in before it was reduced to order; for, treating of the antiquity of the Doric, that it was uſed in the temple of Juno, at Argos, he ſays, that " the ſame order was alſo uſed in the other cities of Achaia, before the laws of its ſymmetry were eſtabliſhed."

This indicates that it was in a more rude ſtate before it was employed in that famous temple.

But if that temple, dedicated to Juno, was erected in the days of Dorus, the king of Argos, as Vitruvius intimates, it would be rather incredible to think that the Doric order ſhould be in exiſtence in times ſo long before Solomon*: and, upon ſuch a ſuppoſition, thoſe who maintain that the firſt idea of the orders was derived from Solomon's temple, would be groſsly miſtaken.

A certain author, after quoting Vitruvius on the ſubject, ſays, " Such is the account given by Vitruvius of the origin of

* Dorus muſt have been, at leaſt, four hundred years before Solomon, if he reigned at Argos before the expedition of the Argonauts.

improvements in the proportion of columns. Had improvements, however, exiſted in ſuch early times, Homer *, who was greatly poſterior to them, would certainly have made mention of ſomething of the kind; but in all his writings he gives us no account of any thing like columns of ſtone, but uſes a word which would rather incline us to think that his columns were nothing more than bare poſts."

This account looks as if there had been neither ſtone columns nor temples till after Homer's days. For if the architecture among the Greeks in thoſe days conſiſted of bare poſts, we cannot ſuppoſe that thoſe magnificent temples which they dedicated to their gods were ſo poor and plain; neither can we imagine that if there had been ſuch fine temples in his time, that he would have left them unnoticed. It would ſeem as if the Greeks had borrowed their firſt notions of temples to worſhip their gods in, and alſo their architecture to adorn them with, from that at Jeruſalem.

Agreeable to this view, the above quoted author ſays: " It is remarkable that improvements in architecture did not take place in any nation till after, or about, the time that Jeruſalem was taken by Nebuchadnezzar. The grandeſt buildings amongſt the Aſſyrians ſeem to have owed their exiſtence to this mo-

* Homer was born above nine hundred years before the Chriſtian æra.

narch; and it can ſcarcely be imagined that he would not endeavour to imitate the architecture of Solomon's temple, to which, by his conqueſt of Jeruſalem, he had full acceſs *."

Upon the whole then, I think it will agree better to the above facts, if we affirm that the Doric order had its name and improvements from the Dorians, who occupied the country of Doris, a Grecian diſtrict, of which Dorus had formerly been king.

The Ionic order ſucceeded the Doric, according to antiquity, and was an improvement from it. It had its name from Ion, the Grecian country or diſtrict where it was invented, and firſt employed in the temple of Diana at Epheſus. By the accounts we have of this temple, architecture muſt have arrived to a conſiderable degree of perfection in theſe times. This temple at Epheſus, the metropolis of Ion, was about four hundred and forty feet long, and two hundred and thirty feet wide; was ſupported by one hundred and twenty-ſeven pillars of the above order, and about ſixty-two feet high. It was built in marble, and decorated with the fineſt ornaments; and, as the hiſtory ſays, exhibited the moſt perfect model of this order.

* According to Prideaux, Nebuchadnezzar took Jeruſalem ſix hundred and five years before Chriſt.

The Corinthian comes next in order, which has its name from Corinth, a city or chief town in Achaia, a Grecian diſtrict or territory. In this city the Corinthian order had its origin. The account which Vitruvius * gives of it is ſomewhat curious and entertaining; I ſhall therefore tranſcribe it.

" The third," ſays he, " which is called Corinthian, is in imitation of the delicacy of virgins; for the limbs are formed more ſlender, and are more graceful in attire. The capital is reported to have been thus invented:—a Corinthian maid, being ſeized with a diſorder, died; after her interment, her nurſe collected, and diſpoſed in a baſket, the toys which pleaſed her when alive, carried it to the tomb, placed it on the top, and, that it might endure the longer in the open air, covered it with a tile. The baſket chanced to be placed over the root of an acanthus, which being thus depreſſed in the middle, the leaves and ſtalks in the ſpring ſeaſon iſſued outward, and grew round the ſides of the baſket; and being preſſed by the weight at the angles of the tile, were made to convolve at the extremities, like volutes. At that time Callimachus, who, for his ingenuity and excellence in the arts, was by the Athenians named Catatechnos †, happening to paſs by this tomb, took notice of the baſket, and being pleaſed

* Vitruvius was an ancient Roman architect, who wrote a ſyſtem of architecture, it is thought, in the time of Titus, the eleventh Roman emperor, who reigned in the year 79, to whom he dedicates the work.

† The firſt of artiſts.

with the delicacy of the foliage growing around it, as well as the novelty of the form, made ſome columns near Corinth according to this model, and from thence eſtabliſhed the ſymmetry, and determined the proportions, of the Corinthian order."

The Tuſcan order is the fourth in point of antiquity, but in the arrangement of the five orders it is put firſt, on account of its ſimplicity and plainneſs. It had its origin in Tuſcany, a place remarkable in Italy, which was firſt inhabited by the ancient Lydians out of Aſia. Theſe people firſt built temples of this order, and dedicated them to their gods in their new plantations. Vitruvius calls it the ruſtic order, which is conſiſtent enough with what I formerly conjectured, namely, that this order was the firſt ſtate of the Doric column in its moſt antique form. And the circumſtance of its being brought from Aſia by the ancient Lydians, helps to confirm it.

The Compoſite is the laſt. Its name denotes that it was compoſed from the other regular orders.

It is alſo called the Roman order, becauſe it was reduced to its proportional ſtandard in that country.

It

It does not appear to be ſo ancient as the days of Vitruvius, as he makes no mention of it. He ſpeaks of various capitals that might be introduced on the Corinthian column, but does not name them. "There are," ſays he, "alſo other kinds of capitals, called by various names, which are diſpoſed on the ſame columns, and which have no proper ſymmetry or relation to any order of columns that can be named differently; but they are all derived and transferred from the Corinthian *."

Theſe words, and the liberty they convey in favour of the compoſition of varieties of capitals to the Corinthian column, it may be preſumed, gave riſe to the compoſition of this order, which, in any other reſpect but the capital, is nearly the ſame with the Corinthian. Some architects, however, do not incline to ſpeak well of it, becauſe it appears to have been picked and culled from all the other orders, and is ſometimes badly arranged, on account of the liberty both taken and granted in this ſpecies of architecture. However, in my opinion, it forms a very beautiful appearance when rightly managed.

The original inventor of the compoſite order is thought to have been one Serlio.

Having now ſaid as much on the antiquity and origin of the five orders, as is neceſſary to give a workman a proper view

* See Newton's Tranſlation of Vitruvius.

of

of the ſubject, I ſhall now proceed to deſcribe the proportions and character of each diſtinct order, and likewiſe explain the names of each moulding.

Of the Tuſcan Order. See Plate VIII.

The Tuſcan order is the moſt ſimple of any of the orders. It is alſo diſtinguiſhable from the other, on account of its ſtrong and maſſive appearance. On which account, in the figurative ſtyle, it has obtained the name of the ruſtic order; and in conformity to this character it is generally employed in farm-houſes, ſtables, and other buildings in the like ſituations. It is, however, ſometimes uſed in grander buildings, where ornaments are not required, but where ſtrength is the principal object.

The proportion of the Tuſcan column, with its pedeſtal and entablature, is as follows:

Divide the whole height, for the complete column, into five, as the figure ſhows. Take one of theſe parts for the pedeſtal as at 1, whence the line is directed that determines the height of the pedeſtal. From this line divide the whole height again into five equal parts, as the ſecond upright ſcale ſhows.

Take one of theſe parts for the whole entablature, and the remaining four is the height of the column, including its baſe and capital. Divide the height aſſigned for the column into ſeven equal parts, as is ſhown on the third upright ſcale. Take one of thoſe ſeven parts for the inferior or lower diameter of the column, not including the projections of the baſe, but ſimply confined to what is commonly called the ſhaft, or cylindrical part of the column. Take half of the inferior diameter, and give it for the height of the baſe, and alſo for the height of the capital, not including the aſtragal at the neck. Proceed next to draw a module, by which to determine the ſmaller parts of the column with the heights and projections of its members, as ſpecified by the upright and horizontal numbers oppoſite to each member on the large ſcale.

Draw a right line at pleaſure. Lay, on this line, a ſpace equal to one diameter. Divide it into ſix equal parts, and draw perpendiculars from each diviſion indefinitely. Lay on five equal diviſions on any of the perpendicular lines, and draw parallels through each.

Draw then two oblique lines, meeting in a point at half of the firſt diviſion 10, which ſpace will then be divided into ten, at the numbers 1, 2, 3, 4, 5, &c. ſo that any number of minutes up to ſixty may be accurately taken from this ſcale.

I have

I have alſo ſhown a module at the bottom of the larger pedeſtal, which is equal to two of the ſmall modules, from which all the minutes are taken and placed as beforementioned, as the Plate of itſelf will make ſufficiently clear by inſpection.

A module is conſidered by ſome as only half a diameter, but others extend it to a whole diameter; which laſt I have adopted, as being the moſt ſimple and entire, and therefore more eaſily remembered by workmen.

Vitruvius uſes the large module, reckoning the proportions of the column by the thickneſs of the lower diameter of its ſhaft. And I do not ſee but it anſwers as nearly to the different parts of a column as the ſemidiameter does, or as that of twenty minutes, which has been contrived by ſome.

The projection of each member is alſo denoted by aliquot, or equal parts; and each part is equal to a minute taken from the ſcale; ſo that if the reader ſhould find any little inaccuracies in the aliquot parts, which it is almoſt impoſſible to avoid in ſuch ſmall ſcales, he may correct theſe by the numbers. And obſerve, that the cornice of the pedeſtal projects 11½ minutes, which is the whole ſum of the projection of each member, denoted by 2, 4, 3, 2½, and which amount to 11½. The baſe of the pedeſtal projects the ſame. Its fillet is two parts; the ogee, or cyma-recta, ſeven and an half; and the ſquare two; which is in all eleven and an half. The baſe of the column projects ten;

the

The conge, or apophyge, four; and the torus ſix. The upper conge of the neck of the capital three, and its aſtragal one and an half. The capital, in all, projects twelve minutes; the firſt fillet two, the ovalo ſeven, the abacuo one before it, and the upper fillet two. The whole projection of the architrave is five, the upper facia one and an half, and its fillet projects three and an half. The whole cornice projects forty-five minutes, and its height is equal to its projection.

Of the Diminution of Columns.

Some diminiſh columns by a right line drawn from the inferior to the ſuperior diameter; but this is very jejune and inſipid, becauſe when columns are finiſhed ſtrictly in this mode, they appear too ſlender in the middle, and loſe that graceful effect which an eaſy curve line produces.

It appears that ſome of the ancients diminiſhed the ſhafts of their columns by a curve line one third from the baſe, as in Plate VIII. whilſt others of them carried this point to an extreme, by drawing a regular curve line from the inferior to the ſuperior diameter, producing a diameter in the middle of the ſhaft larger than that at the bottom. This notion has been

charged upon Vitruvius, becauſe he ſpeaks of " an augmentation that ſhould be made in the middle of columns;" but Mr. Newton, in a note in his book of Vitruvius, has cleared him of this charge. See page 53. And Sir William Chambers takes notice of an author who ſuppoſes the " addition mentioned by Vitruvius to ſignify nothing but the increaſe towards the middle of the column, occaſioned by changing the ſtraight line which at firſt* was in uſe, for a curve."

" This ſuppoſition," ſays Sir William, " is extremely juſt, and founded on what is obſerved in the works of antiquity; where there is no inſtance of columns thicker in the middle than at the bottom, though all have the ſwelling hinted at by Vitruvius, all of them being terminated by curves."

The method that this gentleman recommends as moſt proper for diminiſhing columns, is by an inſtrument which Nicomedes invented to deſcribe the firſt conchoid; for this, being applied at the bottom of the ſhaft, performs at one ſweep both the ſwelling and the diminution; giving ſuch a graceful form to the column, that it is univerſally allowed to be the moſt perfect practice hitherto diſcovered.

* This means, before the orders of architecture had received much improvement.

This

This method has been adopted in the diminution of the Ionic, Compoſite, and Corinthian columns in Plate X, XI, and XII; becauſe theſe are the moſt delicate orders.

But, in the Tuſcan and Doric ſhafts, I have followed the common method; becauſe theſe robuſt columns will admit of more apparent, or more ſudden diminution than the other three.

The moſt common method is as follows. See Plate VIII.

Divide the ſhaft into three equal parts, and draw a diameter at the firſt part. On this diameter deſcribe a ſemicircle, and divide the ſemidiameter into five equal parts. From the fourth diviſion raiſe a perpendicular line which determines the upper diameter and cuts off a portion of the ſemicircle, which is to be divided into four on the curve. Laſtly, divide the upper two thirds of the ſhaft into four equal parts, anſwerable to the four equal parts on the curve; and from each of theſe diviſions, or parts, on the curve, draw right lines to the correſponding diviſions on the ſhaft, by which, four points will be found through which the diminiſhing curve line is to paſs, and, if accurately drawn, will appear ſmooth. Obſerve, this diminution brings the column, at its ſuperior diameter, to forty-eight minutes;

but in all the other orders there are uniformly fifty minutes allowed.

Some architects, however, contend for various degrees of diminution, according to the character of each column. They affign to the Tuſcan one fourth, to the Doric one fifth, to the Ionic one ſixth, to the Compoſite and Corinthian one ſeventh, of the inferior or largeſt diameter.

This makes no difference, however, in the method of diminution above taught; for if the Tuſcan be diminiſhed one fourth, then divide a ſemidiameter into four parts, and take one of thoſe for the diminution on each ſide, and proceed as before; ſo alſo of the other.

I ſhall now quote a few words from Sir William Chambers on this ſubject, by which the reader, if he pleaſe, may form his judgment. He ſays, " In the remains of antiquity, the quantity of diminution is various; but ſeldom leſs than one eighth of the inferior diameter of the column, nor more than one ſixth of it. The laſt of theſe is by Vitruvius eſteemed the moſt perfect. Vignola has employed it in four of his orders, as I have done in all of them, there being no reaſon for diminiſhing the Tuſcan column more in proportion to its diameter than any of the reſt."

How

How to diminiſh any Column, from the inferior to the ſuperior Diameter, by means of an Elliptic Curve not exceeding in its Swell the inferior Diameter.

FIG. 1. Plate XIII. is Vignola's method of diminiſhing a column, the principles of which I have taken from Sir William Chambers' Treatiſe on Architecture, but have here deſcribed it in my own way, as follows. Determine the height of the ſhaft as at *c d*, and draw a line for its axis. Next, draw *b a* at pleaſure, and at right angles with the axis. Let *b c* be half the inferior, and *n d* half the ſuperior diameter. Take *b c* half the under diameter, and with the compaſſes place it from *n*, the extreme point of the upper diameter, to any point where it falls on the axis of the column, as at *o*. From *n* draw a line through *o*, and proceed till it cut the baſe line *b a* at *a*. Draw a line at pleaſure from *b*, the extreme point of the inferior diameter, parallel with *c d*; and divide this line into a number of equal parts, as 2, 4, 6, 8, &c. From *a*, the center, draw a ray or right line to each of theſe diviſions, which will paſs obliquely through the axis, in proportion to their diſtance from the inferior diameter *b c*. Take then *b c*, half the diameter, and place it from 1 to 2, from 3 to 4, and ſo on of all the reſt. Laſtly, through each of theſe points draw a curve line, and the

diminution of one ſide of the column will be thus completed, as is ſhewn by the dotted line on the right hand. To determine the other ſide of the ſhaft, nothing is wanted but to draw a ſquare line acroſs the ſhaft from each point, and place the diſtance 2 *x* to *x y*, and *t* 4 to *t* 9, and ſo on of the reſt.

Fig. 2. is Nicomedes' inſtrument, which, as it is here deſcribed, is intended to perform the ſame diminution as has been above explained by lines.

This inſtrument is made in the manner of a ſquare, with a ſtay to keep it firm, as at R; *b p* is a dovetail groove cut in the center of the upright piece, as T; *b a* is its baſe, in which alſo there is a dovetail groove as at *u*; *i w* is a ruler, or trammel, which moves by the dovetail-piece *y* in the groove *b p*, by which the diminution is performed; *g h* is a plain groove cut through the trammel, and *g* is a center pin which guides the trammel as *i* paſſes from *p* to *b*; when *i* is at *b*, it is evident that *h* will be at *g* the center pin, becauſe *h i* is equal *g b*; alſo *g i* is equal *o a* in Fig. 1. and found in the ſame manner. The interval, or ſpace, between the center *i* and *k* at the end of the trammel, is equal to the inferior diameter *b m*, or *b c*, Fig. 1. As, therefore, the center *i* paſſes to *b*, the center *k*, in which a pencil is fixed, cuts all the oblique lines *j j* tending to *g*, in the ſame points as at

at 2, 4, 6, 8, &c. of Fig. 1. and at the ſame time draws a perfect curve, which I take to be of the elliptic kind.

Laſtly, in order to make this inſtrument anſwer for ſhafts of various ſizes, the plain groove *g b* muſt be lengthened each way to *v* and *w* at pleaſure. The upright *p b*, and the baſe piece N *a*, muſt alſo be proportionably lengthened; and if the center pin *g* be fixed in a moveable piece to ſlide each way in the groove *u*, and fixed at any certain place by a ſcrew, as may be required, then it is evident that the inſtrument may be ſo conſtructed as to anſwer columns of any dimenſion.

Of the principal Parts of a Column, and the Names of each Member.

The principal parts of an entire order are three; the pedeſtal, ſhaft, and entablature.

The pedeſtal is the lowermoſt part of an order, comprehended between *y* and F, ſee Plate VIII. The column is the middle part of it, including the whole ſpace between the pedeſtal and top of the capital. The entablature is the uppermoſt

part

part of the whole, and contains every member between *m*, the top of the capital, and *a*.

Theſe principal parts are again ſubdivided as follows. The pedeſtal contains the plinth F, dado B, and cornice A, *z*, *y*. The column includes a baſe, ſhaft, and capital; and the entablature, an architrave, freeze, and cornice.

Thus, in every entire order there arethree principal parts, and each of theſe parts are again ſubdivided into three ſmaller parts, which in all make nine; the origin of whoſe names is as follows:

F, the plinth, is from πλινθος, *plinthos*, a brick, or flat ſquare ſtone, on which columns, in their moſt antique ſtate, are ſuppoſed to have ſtood.

B, the dado or dye, ſo called becauſe it is of a cubic form.

A, *z*, *y*, the cornice, from the Latin *coronis*, a crowning; becauſe the cornice is the finiſhing, or crowning, of the pedeſtal.

x, *w*, *v*, 2,

x, *w*, *v*, the base of the column, from βασις, *basis*, a foundation or footing for the column.

The shaft is that long and straight part of a column comprehended between the base and capital.

Some derive it from σκαπτω, *skapto*, to dig, in the manner of a well, round and deep, whose inside resembles the shape of a pillar; and some from the long part of an arrow or shaft *.

q, *p*, *o*, *n*, *m*, the capital, from κεφαλη, *kephale*; or *caput*, the head, which the capital is to the column.

l, *k*, *i*, the architrave, so called because it is the chief support to the whole entablature, from αρχος, *archos*, chief or principal; and the Latin *trabs*, a beam.

h, the freeze, " from φιβρον, *phibron*, a border or fringe; or which the ancients used to call ζωφορος, *zophoros*, because it was usually enriched with the figures of animals."

From *g* to *a* is called the cornice, which is the same to the entire order as the pedestal cornice is to it. See A, *z*, *y*.

* The shaft of a mine is the round perpendicular passage they make to come at the ore.

Theſe ſubdiviſions of the entire order have each their particular members, except the dado or freeze; and on the proper arrangement of theſe members depends much of the beauty of the whole.

The names of theſe members are as follows:

a, the fillet, from the French word *fil*, thread.

b, the cymatium, or cyma-recta, from κυματιον, *kumation*, a wave; becauſe this member reſembles the ſwelling and concavity of a wave.

c, the fillet.

d, the corona, or crown; becauſe it is a principal member of the cornice, and ſerves as a ſhelter to the ſmaller members of the entablature.

The hollow part appearing at the underſide of the corona, is termed the *drip*.

e, the ovolo, or Latin *ovum*, which means an egg; becauſe this member, in the Ionic, Compoſite, and Corinthian orders, is generally carved in the ſhape of eggs and darts.

g, the

g, the cavetto, from the Latin *cavus*, hollow.

i, the fillet, liſtel, or ſquare of the architrave.

k, the upper faſcia; and *l* the lower ditto.

m, the upper fillet of the capital.

n, the abacus, from αβαξ, *abax*, a ſhelf or table; or, as ſome ſuppoſe, a tile on which the ancient Greek mathematicians ſtrewed duſt to draw their geometrical ſchemes on.

This word ſeems to have been introduced into architecture on the invention of the Corinthian capital, which had its riſe from an acanthus growing round a baſket with a tile laid over it, as has already been deſcribed from Vitruvius. Conſequently——

o, the ovolo, which is the ſucceeding member, muſt be conſidered as the baſket over which this tile was placed.

p, the lower fillet of the capital; and *q*, the freeze of ditto.

r, the aſtragal, from αςραγαλος, *aſtragalos*, a bone of the heel; or the curvature of the heel, which this member reſembles.

s, the upper ſinćture, which it is thought was anciently an iron hoop, or ferule, to ſecure the ends of the columns, when they were uſed without capitals or baſes.

t, the upper conge or apophyge, from αποφυγη, *apophuge*, eſcape; becauſe that part of the column appears to fly off.

u, the lower ditto; and *v*, the lower ſinćture.

w, the torus, from τορος, *toros*, a cable, which this member reſembles.

x, the plinth of the baſe.

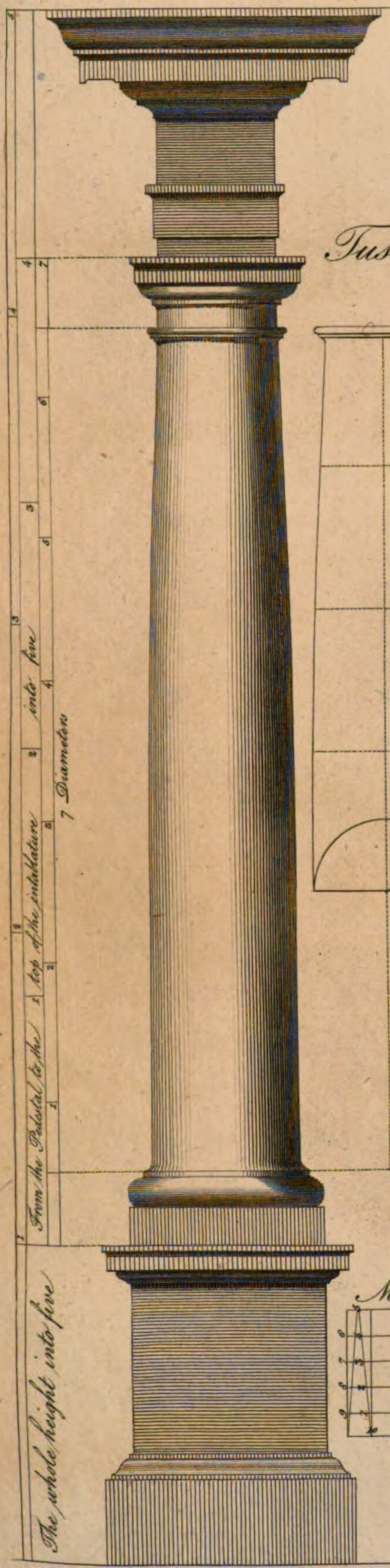
y, the fillet; and *z*, the corona, as before.

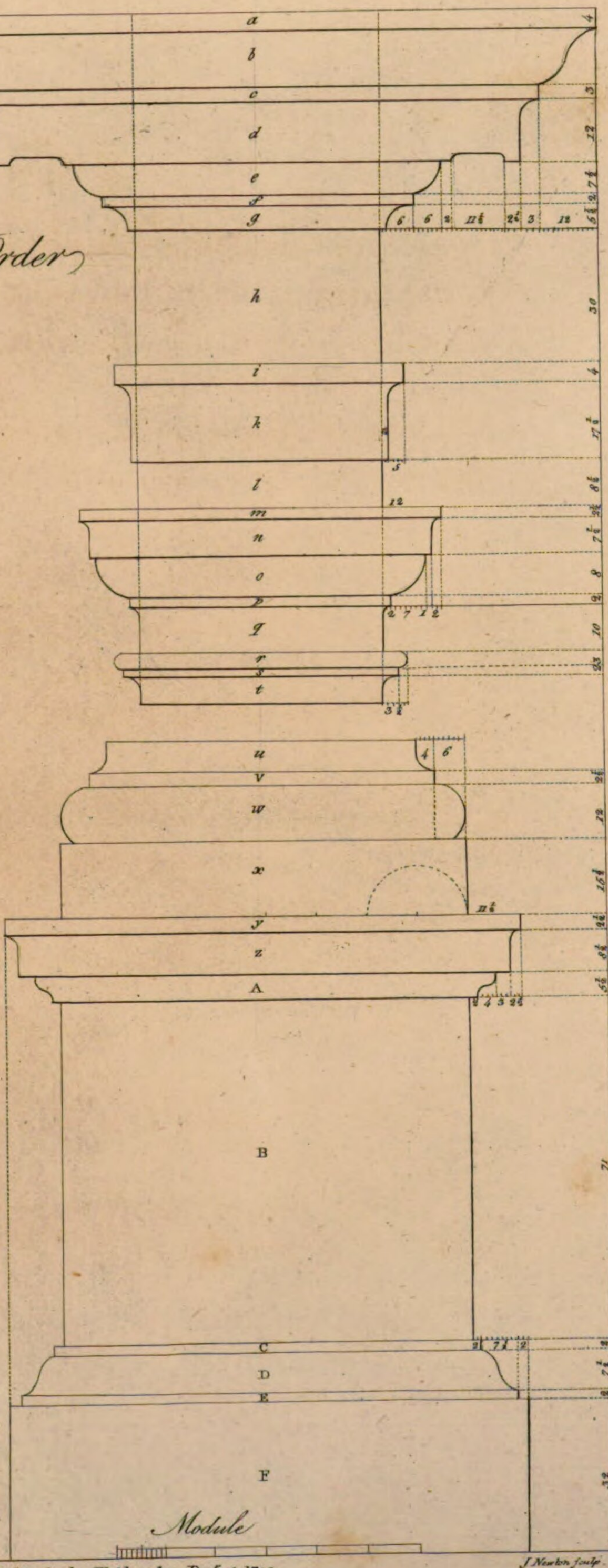
A, the cyma-reverſa, or the cymatium inverted.

D E, the baſe of the plinth, whoſe members are named the ſame as thoſe of the like ſhape already deſcribed.

In

Tuscan Order





In every other column ſimilar members have the ſame name, and therefore I ſhall not repeat them over under the other columns. But as there are ſome members in the ſucceeding orders which differ in character and ſhape from thoſe that have been mentioned already, I ſhall here point them out, to prevent future trouble, and to keep this part of the ſubject of architecture together.

The Doric, Plate IX. for inſtance, has a ſcotia marked A, from σκοτια, *ſkotia*, darkneſs; becauſe of the ſtrong ſhadow which is produced by its own concavity and the projecting aſtragal above it.

m, the conic drops, ſo called from their figure.

k, the triglyphs, from τριγλυφος, *trigluphos*, three engravings. It is a compound of τρι, *tri*, three, and γλυφω, *glupho*, to carve or engrave; in conformity to which derivation, the triglyph has two entire channels, and two half ones, with three ſpaces between. It is ſaid that the triglyphs peculiar to this order were firſt uſed in a temple at Delphos dedicated to Apollo, becauſe his lyre was of this ſhape.

e, *f*, *g*, the mutule, from the Latin *mutuli*, modillion; ſo that, properly ſpeaking, the mutules are to the Doric the ſame as the modillions are to the Compoſite and Corinthian orders.

In

In the Ionic order, Plate X. there are two members which differ from thoſe already mentioned, as *o* the volute, and D the dentils. The volute is ſo called from the Latin *volvendo*, to roll round, as on a ſtaff*. Some call the volutes the horns of the capital, becauſe they pretty much reſemble the twiſting of rams' horns.

The dentils are from *dentelli*, teeth, which they reſemble; and the flat member on which theſe dentils are placed is termed *denticulus*.

The Compoſite capital is adorned with acanthus leaves, and the Corinthian with thoſe of the olive.

Of the Character and general Proportions of the Doric Order.

See Plate IX.

THE character of this order is conſidered by architects as grave and robuſt. Hence, in the figurative ſtyle, it is termed

* The term *volume* has the ſame origin, becauſe anciently they formed books by ſheets of written parchment or bark rolled round a ſtick.

the

the *Herculean Order*; of which order ſome temples were formerly built, and dedicated to Hercules as well as to Apollo.

It is generally uſed in large and ſtrong buildings, as in the gates of cities, and at the outſide of churches. And, as its entablature is of a very large projection, it is generally employed in ſituations where ſhelter is required.

The whole height of the entire order is divided into five equal parts; one of which is the height of the pedeſtal. The column and entablature is divided into five alſo; four of theſe parts are aſſigned for the height of the column, including the baſe and capital; theſe four parts are again divided into eight equal parts, one of which is given for the inferior diameter of the ſhaft. The entablature is two diameters in height, its cornice is forty-five minutes, and its projection is one module. The ſhaft ſometimes is left plain, and ſometimes it is fluted. The number of flutes is twenty or twenty-four, and the depth and curvature of them are determined by drawing an arch from the ſummit of an equilateral triangle, whoſe ſides are equal to the breadth of the flutes, as at *o*.

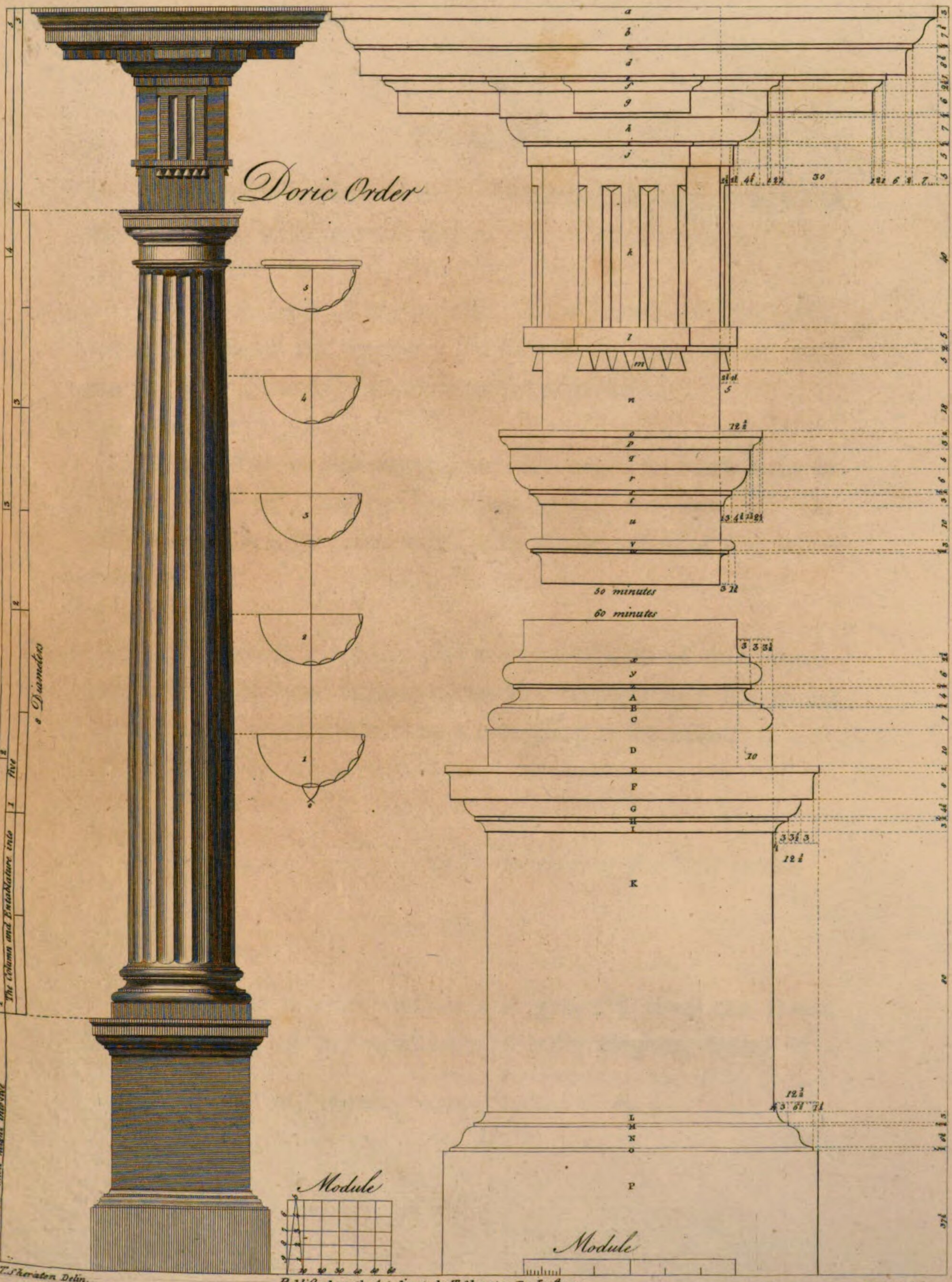
To diminiſh the flutes in proportion to the column, divide the upper two-thirds of the ſhaft into four, and find the ſemicircles 1, 2, 3, 4, 5, in the ſame manner as was taught in the Tuſcan order. Then divide each of theſe ſemicircles into ten

or twelve, and draw the flutes on each ſemicircle from the ſummits of equilateral triangles as above. Laſtly, as the Doric flutes have no fillets, all that remains is to draw a line from each point where the flutes meet, from one ſemicircle to the other, and the lines for the flutes will be thus determined. And obſerve, in all the orders a flute muſt be in the center of a column or pilaſter, not a fillet.

The triglyphs are thirty minutes in breadth, ſee Plate XII. and ſixty-two in height, including the conic drops, and the upper and lower fillets, with the ſmall ſquare above the drops. The channels of the triglyphs form a ſquare or right angle, and their breadth is determined by dividing the whole triglyph into twelve equal parts, and aſſigning two of theſe parts for the channels, two for the ſpaces between them, and one for the half channel on each ſide. The conic drops at bottom are alſo equal to two of thoſe parts; and if two parts be divided into three, one of theſe parts will be the breadth of the upper end of thoſe drops.

The metope, or ſpace between each triglyph, is forty-five minutes, or equal to the height of the triglyph without the fillets. Theſe metopes are ſometimes adorned with ox ſkulls or pateras, whoſe projections ought not to be more than the triglyph itſelf.

Doric Order



T. Sheraton Delin.
Published as the Act directs. by T Sheraton Dec.r 24.th 1791.
J. Newton sculp.

The breadth of the mutules, without their caps, is equal to the triglyphs without their fillets.

The projection of the mutule is the ſame; and the ſoffits, or underſides of the mutules, are ſometimes ornamented with drops of the ſame kind as thoſe of the triglyphs.

The ſoffits of the corona are alſo enriched with roſes in ſquare, and in * lozenge compartments, cut out of the ſolid, including in their depth the whole relief of the ornaments.

With reſpect to the heights and projections of each member, theſe muſt be learned from the upright and horizontal ſcales, and therefore it will be unneceſſary to ſay more.

Of the Character and general Proportions of the Ionic Order.

See Plate X.

THE Ionic is more ſlender and graceful than the Doric. Its ornaments, in my opinion, are truly elegant, being in a

* In the figure of a rhomb. See Plate II. fig. 3.

ſtyle of compoſition between the richneſs of the Corinthian and the plainneſs of the Tuſcan order: for which reaſon, in the figurative ſtyle, it has been compared to a ſedate matron, in decent rather than rich attire.

This order, being of a grave caſt, is often employed in courts of juſtice, and in the inſide of churches, and other places of that kind: in libraries and colleges alſo, and in all places that belong to arts and letters.

The general proportions are as follows:

The height of the entire order is divided into five equal parts. One part is given for the pedeſtal, and the remaining four are divided into ſix; one of which is aſſigned for the height of the entablature, and the remaining five will be the height of the column, including the baſe and capital. The height aſſigned for the column is then divided into nine, one of which is for the inferior diameter or module.

The cornice is forty-four minutes high, and its projection is equal to its height. The drip in the under ſide of the corona is channeled out one minute deep within two of the front, and one minute before the cyma-reverſa.

The

Ionic Order

Profile

30 Minutes
60 Minutes

Module

Module

the whole height into five

the Column and Entablature into Six

9 4 Diameters

D

T. Sheraton Del.
Published as the Act directs by T. Sheraton Jan.y 28.1792.
J. Newton Sc.

The ſhaft of the column is ſometimes fluted and ſometimes plain. Twenty or twenty-four is the number of flutes allowed, and their fillets are one third of the width. The depth of the flutes is determined by a ſemicircle whoſe diameter is equal to the width of them.

How to deſcribe the Ionic Volute.

See PLATE XIII. FIG. 4.

Operation.—Draw the perpendicular A *s*, and make A *s* equal to fifteen minutes. On the center *s* deſcribe a circle whoſe diameter ſhall be equal to three and an half minutes. Draw next a geometrical ſquare, having its ſides equal to the radius of the circle, as 1, 2, 3, 4. From the angles 2, 3, draw a right line to the center of the circle, as at *s*. Divide the ſide of the ſquare 1, 4, into ſix equal parts, as at 5, 9, 12, 8. From 5 draw the line 5, 6 parallel to 1, 2; draw 6, 7 parallel to 2, 3, and 7, 8 parallel to 3, 4. In the ſame manner draw 9, 10, 11, 12, and twelve centers will be found, as at 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12; by which every arch of the volute will be accurately drawn, and each of them coincide with the other—thus: on the center 1 fix one foot of the compaſſes, and extend the other to A: with

 this

this opening ſweep the arch AB. On the center 2, with the compaſſes extended to B, ſweep the arch BC. On the center 3, with the compaſſes extended to C; ſweep the arch CD. On the center 4, with the compaſſes extended to D, ſweep DE, and the volute will be turned once round. For the ſecond time round, begin at center 5, and extend the inſtrument to E, and ſweep EG. On the center 6, with the compaſſes at G, ſweep GH. On the center 7, with the compaſſes at H, ſweep HI. On the center 8, with the compaſſes at I, ſweep IK, and the volute will be turned twice round.

The third time round begins with center 9, from which extend the compaſſes to K, and ſweep KM. On the center 10, with the compaſs foot at M, ſweep MN. On the center 11, with the compaſs foot at N, ſweep NO. And laſtly, on the center 12, with the compaſs foot at O, ſweep OP, which will complete the volute three times round.

Obſerve, that the whole volute is compoſed of twelve quadrants of a circle, drawn from twelve centers, and gradually contracted in by means of the diagonal lines in the eye, ſee Fig. 3. Therefore, as there are three complete turnings in the whole convolution, each of theſe turnings is made up of four quadrants.

How to graduate the Liſt or Fillet of the Volute.

MAKE the breadth of the fillet at A equal to two minutes; or, according to ſome, one and ſeven eighths, or one and two thirds. Conſtruct a triangle, as at Fig. 5, whoſe ſides A P, V P, ſhall be equal to the length of the cathetus, or upright line A P, Fig. 4. Make A V, Fig. 5, equal to half the ſide of the ſquare in the eye of the volute, Fig. 4. Draw then the line L S, Fig. 5, at a diſtance from A V, equal to the breadth of the fillet at A, Fig. 4. Take the length L S from Fig. 5, and place it each way from S in the eye of the volute, or as from V to S in the large eye, Fig. 3. V S is divided into three equal parts, which are ſhewn by the dotted lines; and where theſe dotted lines interſect with the diagonal lines in the ſquare, they will find twelve new centers, which will deſcribe the diminution of the liſt or fillet by the ſame proceſs that was uſed in drawing the exterior contour or outline of the volute above explained.

For the other enrichments of the Ionic capital, ſee the plan in Plate XII. and obſerve, that over every flute in the ſhaft is placed an ove, or egg, in the ovolo.

Of

Of the Character and general Proportions of the Compoſite Order.

See Plate XII.

THIS order is generally placed laſt of the five, becauſe it was a compoſition from them, and of the lateſt invention. But, according to this reaſoning, the Doric ſhould be firſt in order, becauſe it was the moſt ancient; however there are two reaſons which have induced me to place the Compoſite as the fourth. Firſt, becauſe it is the fourth when orders are placed upon orders in large and magnificent buildings, where it is obſervable that the more maſſive and plain columns are neareſt the foundation, as firſt the Tuſcan, ſecond the Doric, third the Ionic, fourth the Compoſite, and laſt the Corinthian. Second, becauſe it is the fourth in point of richneſs and delicacy, for as they decreaſe in ſtrength they increaſe in richneſs of ornaments; their elevation above the ground is therefore regulated both by degrees of ſtrength and richneſs of compoſition. But to give a proper ſanction to this little novelty in the arrangement of the orders, it may be proper to quote ſome great man of this opinion. Sir William Chambers* ſays, " Moſt authors give the

* From whoſe excellent Treatiſe on Architecture I have borrowed ſome of the proportions which are found in my orders, as alſo from Mr. Richardſon's.

laſt

laſt place to the Compoſite order, as being the laſt invented, and a compound, which of courſe ought to be preceded by all the ſimples. I have followed Scamozzi's method; his arrangement appearing to me the moſt natural; for his orders ſucceed each other according to their degrees of ſtrength, and in the progreſſion that muſt abſolutely be obſerved whenever they are employed together."

The proportions of the Compoſite, and its enrichments and delicacy, being nearly the ſame with that of the Corinthian order, in the figurative ſtyle it may be properly enough termed one of the virginal orders, and was therefore uſed in ſome temples of the female deities.

It is, however, generally employed in triumphal arches, for as the Romans compoſed this from the Græcian orders, ſo they made uſe of it in thoſe ſituations to expreſs ſymbolically their conqueſts over thoſe nations. I have therefore, in conformity to this, repreſented a trophy of war in the freeze, which I think would have a good effect placed over the center of each column, with other ornaments between them ſuited to the character of this order.

The Compoſite may alſo be employed in monuments of ſignal events, and in ſuch buildings as are intended to per-

petuate

petuate the memory of the great actions of particular perſons.

The general proportions of this order are as follows:

The height of the entire order is divided into five, as uſual; one of which is appropriated for the height of the pedeſtal. The remaining four is for the height of the column and entablature. Theſe four parts being again divided into ſix, the upper one is aſſigned for the height of the whole entablature, and the remaining five of theſe parts are for the height of the column, including the baſe and capital. The height of the column is divided into ten equal parts, one of which is for the inferior diameter. The baſe is thirty minutes, without the upper aſtragal; and the capital is ſeventy minutes high, adorned with the acanthus leaves, and volutes drawn by the ſame method as that of the Ionic. The plan of the capital being drawn in the ſame manner as that of the Corinthian, I ſhall explain the particulars of it under that order.

The ſoffit of the corona is divided into ſquare compartments, cut out of the ſolid, decorated with roſes, &c. whoſe relief muſt not project more than the borders which incloſe them. In rich compoſitions the ſoffits of the modillions are alſo ornamented, but their relief is not to exceed the horizontal ſurface,

Composite or Roman Order.

The whole height 186 feet

The Column and Entablature 160 Sic.

4 (0) Diameters

Qua^r. Plan of Capital

Module

Module

T. Sheraton Del.

Publighid as the Act directs by T. Sheraton February 16. 1792.

J. Newton Sc.

otherwiſe it would greatly injure the effect of the modillion, and render the appearance of the profile of the entablature leſs pleaſing.

Of the Character and general Proportions of the Corinthian Order.

See Plate XII.

THE Corinthian, or laſt order, is certainly the moſt rich and graceful in its appearance of any other. To ſpeak in the figurative ſtyle, it has all the delicacy of a female youth, and has therefore been termed the verginal column or order; on which account it is employed in the apartments of young ladies: but, for its richneſs and grandeur, it obtains a place in the palaces of kings, and the moſt ſuperb buildings. It is alſo uſed in public ſquares, and all places of gaiety.

The general proportions of this order are as follows:

The whole height of the entire order is, as in all the others, divided into five, and one is given for the pedeſtal. The remaining four are then divided into ſix, and one part is aſſigned

to the whole height of the entablature. The four parts which are left include the height of the column, with its baſe and capital, and are divided into ten equal parts, one of which is given for the inferior diameter of the ſhaft. The baſe is thirty minutes high without the upper aſtragal, and the capital is ſeventy minutes clear of the necking. The cornice is forty-eight minutes in height, and its projection the ſame.

The ſoffit of the corona is worked in ſquare compartments, as in the Compoſite; but the under ſides of the modillions are ornamented with an olive leaf, the ſame as in the capital. The abacus of the capital is ſometimes fluted, and ſometimes plain. The volutes ſometimes riſe higher than the under ſide of the abacus, but the capital looks beſt when thy are bounded by the under ſurface of the abacus.

The plan of the capital, and the poſition of the leaves as they appear on the round ſurface of the capital, are thus determined.—Let *de*, in Fig. E, be equal to the inferior diameter of the column: ſweep the arch *e g* at pleaſure; then biſect the arch by turning the ſweeps *d o* on the centers *e g*; draw *d o*, the angular line of the capital.

From the angular line place five minutes each way, as at *m* and *n*. Take *m o*, and place it from *a* to *o*; then take the

whole ſpace *m o* in the compaſſes, and ſweep an arch each way interſecting at *p*. From the center *p*, ſweep the front of the abacus *m t*, and ſo of all the other ſides of the capital.

Take half the ſuperior diameter of the ſhaft, and with it ſweep the arch *c r e*; then extend the compaſſes ſeven minutes further, and ſweep the arch 7, which determines the projection of the firſt row of leaves. Laſtly, extend the compaſſes to ſix minutes further, and ſweep the arch 6, which will determine the ſecond row of leaves. Divide the quadrant *c r e* into four equal parts, and draw the radii *d c*, *d r*, *d e*, which lines will determine the ſtem of each leaf. From the centers *c e*, draw ſemicircles, as they appear in the plan.

From *c r e* let fall perpendiculars, and the points 1, 2, 3, 4, will determine the ſituation of the leaves in the capital. Therefore take the diſtances 1, 2, 3, 4, from the plan E, and place them on the capital, as 1, 2, 3, 4, each way from the center; and from theſe raiſe perpendiculars, which will be the apparent place of the ſtem of each leaf. How the leaves are formed muſt be evident by inſpection, and therefore I ſhall not enlarge further on the ſubject.

How to draw the Scotia Moulding.

FIG. *c* is the ſcotia, whoſe height, without its fillets, muſt be divided into ſeven. On the fourth diviſion draw a line *r d* parallel with the fillets. Take the upper three parts in the compaſſes and draw a circle. Make *d a* equal *d n*, or four parts. From *a*, draw *a r p* indefinitely, cutting the aforeſaid circle at *p*. Laſtly, fix the compaſs foot at *a*, and extending the other to *p*, ſweep the arch *p n*, and the ſcotia will be completed.

The cyma-recta A is drawn from the ſummits of equilateral triangles thus: draw *v w*, and biſect it at *x*. Extend the compaſſes *x* to *v*, and turn two arches at 3, and their interſection is the center for the convex part. In the ſame manner *y* is the center for the concave part, which completes the moulding.

How the cyma-inverſa B is drawn, muſt be evident by inſpection; and with reſpect to any other kind of moulding, they are either conſidered as quadrants, or as ſemicircles, or nearly ſo; as the aſtragals, torus, ovolo, conge, and cavetto.

Corinthian Order.

Column and Entablature into Six

Module.

Module.

A

B

D

Half Plan of Ionic Capital

Quarter Plan of Corinthian Capital

E

C

T. Sheraton delint.

Published as the Act directs March 17. 1792. by T. Sheraton.

J. Newton Sculp.

Two methods of diminishing the shaft of a Column.

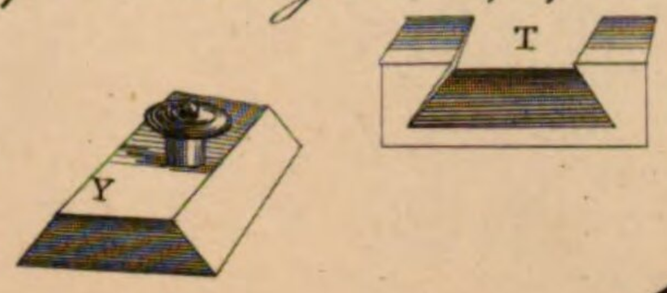
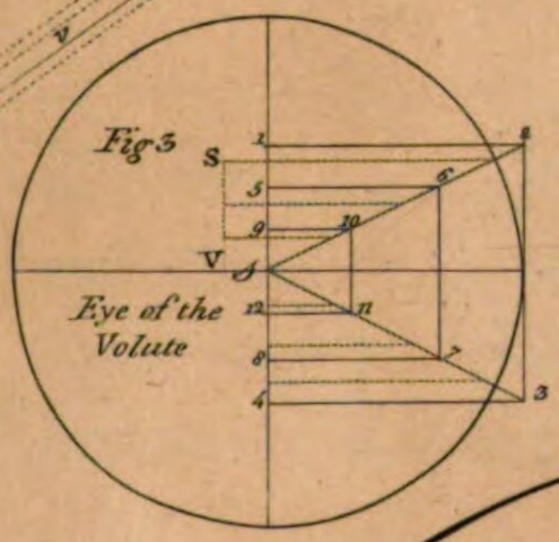
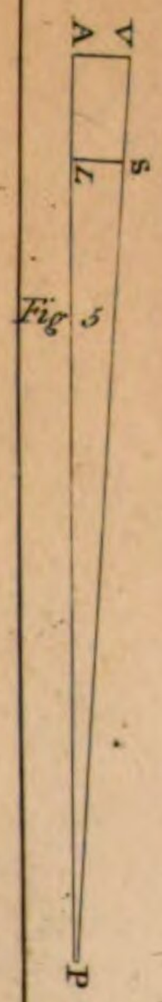


Fig 1.

Fig 2.





T. Sheraton delin.

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J. Barlow sculp.

Obſervations on the Agreement of the Five Orders to each other.

THE height of every entire order is divided into five equal parts; of which one is given for the height of the pedeſtal, and the remaining four are for the column and entablature.

In the Tuſcan and Doric orders theſe four parts are divided into five, the uppermoſt part of which is for the height of the entablature; and the remaining four in the Tuſcan, are divided into ſeven, and one is given for the diameter; and in the Doric into eight, and one is aſſigned for the inferior diameter.

In the Ionic, Compoſite, and the Corinthian orders, the four remaining parts from the height of the pedeſtal are divided into ſix, the uppermoſt of which is for the height of the entablature of each order; and the remaining five, in the Ionic, are divided into nine, and one is for the inferior diameter; but in the Compoſite and Corinthian theſe five parts are divided into ten, and one is aſſigned for the lower diameter of each column.

In

In every order the plinth of the pedeſtal and its cornice are equal in projection; that is, one perpendicular line ſerves to determine the projection of both.

In every order, without exception, the baſe of each column is thirty minutes, or half a diameter, high; and, in the Tuſcan, Doric, and Ionic, the height of the capitals is the ſame; but in the Compoſite and Corinthian their capitals are each of them ſeventy minutes.

In every order the projection of the baſe at the bottom of the ſhaft is ten minutes; or, which is the ſame thing, the diameter of each ſhaft being divided into ſix, one of them is ſet forward for the projection of the baſe.

In every order its quantity of diminution may be the ſame, which is ten minutes; but in my examples the Tuſcan and Doric are rather more.

Laſtly, all the orders, except the Doric, have their cornices to project as much as they riſe; but in the Doric the cornice projects one quarter part more than it riſes.

Theſe remarks, if retained in the memory, may help to facilitate the trouble which neceſſarily attends in drawing the five orders. Beſides, it is ſometimes required of a workman to give ſome anſwer to his employer reſpecting the general proportions of the orders; and, if he is not acquainted with as much of them as I have briefly laid down in the above obſervations, he muſt of courſe look very fooliſh in the eye of his queriſt, for he cannot then have recourſe to his book. But further, a workman who has profeſſedly gone through the five orders, by drawing them under the direction of ſome maſter, cuts but a poor figure in a converſation on the ſubject of architecture and proportion, when perhaps, after all, he is unable to recollect one ſingle particular reſpecting them.

Of the general Proportions of Frontiſpieces adapted to the Five Orders.

THE Tuſcan frontiſpiece allows ſix diameters from center to center of each column or pilaſter, as deſcribed in Plate V. and page 88.

The

The Doric allows ſix and a quarter, or one third. The Ionic ſix and a half; ſome make it ſeven and a quarter. The Compoſite ſeven; ſome allow ſeven and a quarter. And the Corinthian ſeven diameters and thirty-five minutes; or, as ſome have it, eight diameters.

Theſe different intercolumniations are nearly proportioned to the ſtrength or delicacy of each order, ſo that the aperture, or opening for the door of each frontiſpiece, is much the ſame in all the orders. For though the Tuſcan order only allows ſix diameters, yet ſix of theſe are equal to ſix and an half diameters of the Doric column. And the Corinthian, though it allows at leaſt ſeven diameters for its intercolumniation, the opening for the door-way will not, at that rate, be quite equal to ſix diameters of the Tuſcan column.

This ſufficiently accounts for the different number of diameters aſſigned by architects for the door-ways or intercolumns of the frontiſpieces adapted to each order.

The proportion of doors is generally in height twice their breadth; but, in ſome caſes, a little more height is requiſite.

The width of the door is divided into four equal parts; one of which is for the diameter of the column, or breadth of the pilaſter. Half a diameter is added to each ſide of the column, for the impoſt or ground which receives the projections of the plinth and capital.

Half a diameter is alſo allowed above the door to the under-ſide of the architrave, and one for the ſub-plinth, or the ſquare part on which the baſe reſts. According to this proportion, from the top of the ſub-plinth to the top of the column there will be ſeven diameters and an half; which will be within half a diameter of the full ſize of the Doric column, according to the order; but if there be a ſtep up to the entrance of the door, this will increaſe the column to its full height, which is eight diameters.

To the height of the column muſt be added two diameters for the whole entablature above the capital: and for every other particular reſpecting the mouldings, the reader muſt have recourſe to the orders themſelves.

General Directions for drawing the Five Orders in Indian Ink.

It is beſt to procure wove paper, becauſe its ſubſtance will bear a better ſhade, and its quality gives a more handſome appearance to a drawing, than the more common ſort. The paper ſhould be regularly damped, and paſted round the edges, ſo that when it dries it will become tight and even in its ſurface.

Proceed then to draw a perpendicular line for the axis of the column, and on this line place the ſeveral heights required. Through each of theſe heights draw, by the pencil, lines at pleaſure parallel to the baſe.

Next find the inferior diameter of the column, and afterwards the ſuperior one. From the extremities of the ſuperior diameter draw perpendicular lines upwards, and from the extreme points of the inferior diameter draw perpendicular lines downwards to the top of the pedeſtal. From theſe lines place the projection of the baſe, and from the projection of the baſe each way, draw two other perpendicular lines down to the baſe of the plinth.

Thus

Thus far the drawing is prepared for laying on the projections of the ſeveral members which take their ſpring from the above perpendicular lines, and when the mouldings are all drawn by the pencil, the ſtrokes of the pencil ſhould be tendered or made fainter by the Indian rubber, ſo that the ſtrokes of ink may be more clearly ſeen as they are drawn, and ſo prevented from being too ſtrong, which if they are, the drawing is totally ſpoiled.

If the drawing be on a large ſcale, as thoſe detached in the plates, the compaſſes may be ſucceſsfully applied in drawing the curved members; but if they are ſmall, like the finiſhed and entire orders in thoſe plates, they muſt be drawn by a fine pointed camel's hair pencil, guided by a ſteady hand.

The application of any kind of writing ink to the outlines of the drawing muſt always be avoided, becauſe it neither agrees with the nature or colour of Indian ink. The writing ink not only makes an outline too harſh in appearance, but likewiſe deſtroys the effect of the Indian ink; becauſe the water that is mixed with the Indian extracts the quality of the writing ink, and of courſe they blend together in one maſs, and the ſhadow becomes partly blue and partly black, which deſtroys the harmony of the whole. Therefore mix good Indian ink by rubbing it on a marble ſtone, and let the ink ſtand a few hours,

till the groſſer particles ſettle to the bottom. Add a little water to a part of it, to make a light ſhade with; and with this light kind mark the outlines of the column, applying the hair pencil to the curved parts, and the braſs pen to thoſe which are ſtraight.

After this proceſs rub the drawing quite clean; and obſerve this as a general maxim, that the fainter the outline the better, provided it can juſt be diſcerned.

The next things to be conſidered are light and ſhadow, which are oppoſite in themſelves; but if diſconnected, no good effect can be produced in a drawing. Wherefore, where a ſtrong light is ſuppoſed, there muſt alſo be a ſtrong ſhadow agreeing with it; and where the light is weak, the ſhadow is leſs dark in proportion to it.

Rays of light do not project ſhadows contrary ways at the ſame time. Therefore the point of light muſt be fixed in the mind at leaſt, if not on the paper, from whence the rays are directed in parallel lines to the object, which produce a ſhadow on the contrary ſide to that which the light comes from. Proceed then to lay on a weak tint on that ſide of the ſhaft which is oppoſite the light; and the breadth of this tint muſt be proportioned according as the light is ſuppoſed to come, either directly

rectly on the front of the picture, or obliquely to it. If the light comes on the front, the tint is narrow; but if obliquely on the picture, the tint is broader, or comes farther on to the center of the ſhaft in proportion to the degree of obliquity. After having laid on the firſt tint according to theſe principles, a ſecond tint muſt be applied in darker Indian ink; but the dark tint muſt not be carried plump to the outline of the dark ſide, becauſe that would deſtroy roundneſs; for, in nature, all round or cylindrical bodies have a reflected light; but this reflected light is not equal in ſtrength to the direct light, wherefore the firſt or weak tint of Indian ink is ſuppoſed to be equal in degree to the reflected light, conſequently a ſmall portion of the firſt tint is left on the edge of the ſhaft, which is graduated or ſoftened into the ſecond tint, which is ſtrong, producing a maſs of ſhade, blending itſelf in regular gradation with the firſt tint towards the center of the ſhaft. After the ſecond tint is perfectly dry, a third ſtill ſtronger ſhould be applied, in order to complete a high-finiſhed drawing; but care muſt be taken to lay it on about the center of the ſecond tint, and not broad, but plump, ſoftened a little off at the edges, which will produce a ſufficient roundneſs, if rightly managed.

If the ſhaft is repreſented as fluted, its ſhading will yet require more management; but the ſame principles muſt be obſerved. In managing the flutes, it will be proper to mark their

boundaries

boundaries firſt with a nice braſs drawing-pen, filled with thin Indian ink, that it may diſtribute and paſs eaſily through the pen, leaving a very faint line on the light ſide, ſcarcely to be ſeen; but in ruling the dark ſide the ink muſt be laid on ſtronger, that the outline of the flutes may not be totally loſt when the ſhade is laid on. After the firſt tint of ſhade is applied, it will be requiſite then to touch in the dark ſides of the flutes. Thoſe on the dark ſide of the ſhaft may be done by the hair pencil; but if the drawing is on a ſmall ſcale, the braſs pen will do much better on the light ſide; becauſe, by drawing parallel lines with that inſtrument in imitation of graving ſtrokes, it will produce a ſhade in the flute more conſonant, and in better tone with the light ſide of the ſhaft, than can be performed by the hair pencil.

The flutes on the dark ſide of the ſhaft muſt not be all black, for their concavity will reflect a dim light oppoſite to their dark ſide, upon the ſame principles by which light is reflected on convex ſurfaces. Laſtly, when the flutings are thus handled, a ſecond tint of Indian ink muſt be laid on at the dark ſide, by which the flutes and fillets muſt be made to harmonize, and appear in one maſs of ſhade, without deſtroying their diſtinction. In general, the ſecond tint is ſtrong enough for fluted ſhafts, becauſe the outlines for the flutes contribute towards a ſhade themſelves.

The

The mouldings muſt next be conſidered: and as theſe are in a different poſition from the ſhaft, conſequently the light muſt ſtrike them differently.

In the examples given, I have ſuppoſed the aperture, or point of light, above the top of the column; which is a ſituation highly advantageous to the drawing, becauſe, upon this principle, there will be a regular ſtrong ſhadow under each covering member productive of a good effect.

Hence, in the Ionic, for inſtance, the hollow, or upper part of the cyma-recta, has a ſtrong ſhade; and the ſwelling part is light in the center, bearing a ſhade downwards as it recedes back. The corona is alſo light, becauſe the rays come full upon it; but the cyma-reverſa, dentils, and ovolo, are all in ſhadow, on account of the large projection of the corona, which ſcreens them from the light. The left hand volute projects a ſhadow on the ſhaft, and the curved top of each flute does the ſame. The lower ends of the flutes are light, for the rays come full upon them; but the upper part of the ſcotia in the baſe bears a ſtrong ſhade, becauſe it is totally covered by the projection of the upper aſtragal.

The cornice of the pedeſtal is nearly all in ſhadow; but the

baſe is nearly all light, for there is nothing to prevent the rays falling upon almoſt every part of it.

Theſe obſervations, with the exerciſe of a little taſte and good ſenſe, will, I preſume, enable the learner to accompliſh his attempt to ſhade the five orders in ſuch a manner as will do him credit.

END OF THE FIRST PART.

THE

CABINET-MAKER AND UPHOLSTERER'S DRAWING-BOOK.

PART II.

ON PRACTICAL PERSPECTIVE APPLIED TO THE ART OF REPRESENTING ALL KINDS OF FURNITURE IN DIFFERENT SITUATIONS: COMPREHENDING A REGULAR AND FAMILIAR TREATISE ON THIS USEFUL SCIENCE, DIGESTED AGREEABLY TO THE AUTHOR'S OWN EXPERIENCE IN THE ART FROM SOME YEARS PRACTICE, AND FROM OBSERVATIONS ON THE PRINCIPAL WRITERS ON THE SUBJECT; VIZ. DR. BROOK TAYLOR, DR. PRIESTLEY, MALTON, KIRBY, NOBLE, AND SOME OTHERS.

INTRODUCTION.

THAT the knowledge of perſpective is highly uſeful to Cabinet-makers, Upholſterers, Chair-makers, Joiners, and other perſons concerned with deſigning, cannot be diſputed on good grounds. And, though this is an indubitable poſition, yet many in the above profeſſions are not ſufficiently, if at all, acquainted with it. This defect in their education, or neglect in their own application, neceſſarily ſubjects ſuch to conſiderable

diſadvantages, both with reſpect to giving and receiving orders. A maſter cannot poſſibly convey to the workmen ſo juſt an idea of a piece of furniture by a verbal deſcription, as may be done by a good ſketch, proportioned according to the laws of perſpective, and ſituated ſo as to give the moſt general and clear view of the whole piece. Nor, on the other hand, can a workman ſo well underſtand the meaning of a drawing, and what it is intended to repreſent, without ſome knowledge of the art I am pleading for; and conſequently his progreſs in executing the work will be proportionably retarded, and, perhaps, not ſo exactly finiſhed at laſt. On theſe accounts it is a maſter's intereſt to know perſpective himſelf, and to have men about him that underſtand it. When this is the caſe, time is often gained, ſtuff ſpared, and diſgrace avoided; ſince it is matter of fact, that many alterations in pieces of work of every kind take place; ſometimes owing to bad ſketches or drawings, and ſometimes from want of underſtanding a good deſign when it is given to work by. There are ſome maſters, indeed, who will ſcarcely allow their foremen time to make any kind of ſketch; but, if I may offer my opinion on this head, I muſt ſay that ſuch a method of carrying on buſineſs neither reflects honour on the foreman, nor in the end turns out to any advantage to the maſter; but, on the other hand, frequently a conſiderable loſs.

Beſides, as it is the preſent mode to introduce much painting in furniture, it is of great uſe to know perſpective, in order to underſtand when ſuch painting has its proper effect, and to enable the director of work, whether maſter or foreman, to point out ſuch improprieties as may eſcape the notice of the painter; and which, if entirely overlooked, might prove injurious to the work, and offenſive to a cuſtomer of taſte.

To theſe we may mention another advantage that often ariſes to a maſter from knowing this art; ſince, by it, he may often fix the judgment and mind of a gentleman or lady reſpecting the piece of furniture they wiſh for, by producing either a drawing that has been previouſly made, or by being able, off hand, to furniſh their ideas with a good pencil ſketch. In ſhort, a good perſpective drawing may be ſent to a gentleman or lady in the country, with almoſt as much confidence of ſucceſs as if a model of the piece of work were ſent.

Laſtly, if the reader conſider himſelf a gentleman, or as poſſeſſed of a liberal education, and at the ſame time entirely unacquainted with this fine art, it will carry in it an air of contradiction; becauſe perſpective is founded on geometrical and optical reaſoning, and has therefore always been conſidered as a branch of the mathematics and of a liberal education. Yet it is my intention not to treat the ſubject mathematically,

becauſe many have done it already in ſuch a manner as far exceeds any thing I can pretend to; and becauſe it would not ſuit workmen, for whom the following treatiſe is intended. If, however, any other above this ſphere can reap any information from it on account of its ſimplicity, I ſhall be happy to have ſerved them; but if he be above receiving inſtruction through that channel or medium which is only intended to convey the knowledge of this art to workmen, the reader may conſult ſome of thoſe authors referred to in the title, where he will ſee problems, theorems, demonſtrations, and corollaries enough to fill his leiſure hours with, and to carry the ſcience to any length he pleaſes. However, to look into ſome of theſe books would greatly diſcourage many workmen, and even ſome others of a higher claſs, who diſlike the drudgery of peruſing and comparing an infinite number of references to a variety of ſchemes, which are rather more calculated to ſhew how far the ſubject may be carried by mathematical ſkill, than to inform the reader of ſuch principles as may be wanted in the practice of the art, or to give him a tolerable view of the theory on which the ſcience is founded.

And it may be aſſigned as one reaſon why the ſubject of perſpective is ſo little known amongſt workmen, that it has been treated too mathematically. For, though geometry muſt aſſiſt in ſtating theories, and in making new and additional diſ-

coveries

coveries of the principles of the art, yet we muſt not infer from hence that a workman cannot learn the practice of the art without being acquainted with that ſcience.

Malton ſays the ſame thing in the preface to his Treatiſe on Perſpective. " Perhaps," he obſerves, " the demonſtrations of the laſt (meaning the laſt theorem of his fourth ſection) may deter thoſe who are not geometricians from examining it with that attention it requires; let ſuch remember, that, in order to practiſe perſpective, it is not abſolutely neceſſary to be a geometrician, becauſe I practiſed it long before I underſtood geometry."

In fine, I ſhall only ſay, that it has been my aim to put into the hand of the ingenious workman ſuch a view of the ſubject of perſpective, applied to as general a variety of caſes, as may enable him to get through with deſigning any thing he meets with in the courſe of his buſineſs: and if any thing more than this be found in this treatiſe, the reader will ſee more than what is promiſed; which may probably incline him to acquieſce with the author's ſentiment, that it is better to do more than we ſay, than fall ſhort of what we have promiſed.

SECTION

SECTION I.

Of the Principles on which Perſpective is founded, and the Definitions of thoſe Terms neceſſarily uſed on the Subject.

THE principles on which the art is built are founded on the nature of our ſight, which invariably comprehends all objects under ſome angle of a leſs or greater degree, in proportion as the object is at a greater or leſs diſtance from the eye of the ſpectator.

Hence let A, Fig. 1. Plate XIV. be conſidered the human eye, which is nearly globular; and P the pupil *, or that extremely ſmall point of the eye into which the rays of light iſſuing from every part of illumined objects in right-lined directions all converge.

* The term *pupil*, in general, means a youth or minor under the tuition and management of a maſter or guardian; but why it has been introduced into optics, and applied to the aperture or ſmall opening of the eye which receives the light, is owing to the little image—or *pupilla*, a puppet—which is reflected in the eye, and ſeen by every one who looks ſteadily on it, which is no other than the ſpectator himſelf, whoſe image in miniature is reflected on the cryſtalline humour.

Thus

Thus the rays BP and DP, iſſuing from the ſerpentine figure BD, are ſaid to converge, becauſe they unite in a point at P, the pupil; and, after paſſing through the pupil and continuing in their direct courſe, they diverge or ſpread open as at *n m r q v t*, on that part of the eye called the retina*, by which an object is formed ſimilar to the originals BD, EC, FG, and in magnitude according to their different diſtances from the eye†. Therefore, as the firſt object BD is neareſt to the pupil P, the points *n t* on the retina are moſt extended, becauſe the angle DPB, under which the object BD is ſeen, is conſiderably larger than thoſe under which the objects EC and FG are ſeen.

And again, as the ſame object is removed back to EC, the rays are leſs extended on the retina as at *m v*; but if the object be removed ſtill further from the ſight P to FG, the rays will ſtill diverge leſs, and conſequently the object painted on the retina will be proportionably ſmaller as at *r q*. And thus, by removing the object FC ſtill further and further from the ſight, it would be ſeen under a proportionably ſmaller angle, until

* Retina, from *rete*, a net; becauſe this part of the eye is a fine expanded membrane, ſomewhat open like a net, and ſpread over the bottom of the eye, on which are painted the pictures of all the objects we perceive.

† The refraction of the rays of light occaſioned by their paſſing through the different mediums or humours of the eye, has nothing to do with perſpective; it belongs to optics only, on which Ferguſon's Lectures may be conſulted, and others on the ſubject.

it would at length vaniſh into a point, and loſe its appearance.

That the rays of light, by which we are made ſenſible of objects, make their way to the organs of ſight in right-lined directions, is evident from a moſt ſimple experiment: for, if the bore of a tube or pipe be as much curved as is equal to the diameter of the bore, nothing can be ſeen through it; or if one object ſtanding before another of equal magnitude on the ſame line, be viewed by a perſon ſtanding on that line, the laſt will be hid, provided they both ſtand upright. I ſimply mean, if the ſhafts of two columns of equal diameters were placed upright, and a ſpectator were ſtanding upright on a line paſſing through the centers of each ſhaft, the laſt one could not be ſeen; but if viſion, or the faculty of ſeeing, were performed by rays of light in curved directions, perhaps this would alter the caſe, but not for the better, as I am certain that the conſtruction of our eye, and the way in which we, at preſent, diſcover objects, are the perfect productions of Infinite Wiſdom.

From what has been ſaid and referred to in the figure, I preſume that the reader is not altogether ignorant of theſe two things: firſt, that all objects appear to the ſpectator proportionably leſs the further they are removed from the eye; and, ſecond, that the rays of light coming from every part of il-

lumined objects operate on the eye in right-lined directions. These two propositions being admitted as certain truths, two very considerable points in perspective will hereby be gained. First, that in the representations of objects originally of the same dimensions, those which are furthest from the front of the picture must be least, in proportion to the supposed or real distance of the spectator's eye from the object: and second, that a right line from the top and bottom of the front objects, terminating in a point on the horizon, will determine the heights of all those back objects which are originally of an equal height with those on the front.

Hence, if a range of columns be represented on a picture, a right-line from the top and bottom of the first column to some point in the picture, will determine the heights of all those behind. Experience will convince us of the truth of this: for if we place ourselves at a distance from a straight row of columns, standing a little to one side, and looking attentively from the first to the last column, we shall then see that the pillars will appear to diminish backward in the form of a triangle; or, in other words, the tops and bottoms of each column will seem to tend to one point.

The same may be observed by standing close to a long brick wall, and ranging the eye along the joints of the bricks; we

ſhall ſee each joint ſeemingly terminating into one point. Thoſe joints below the eye will appear to riſe up, and thoſe above it will ſeem to lower; and if the length of the wall were continued as far as we could ſee, the joints would apparently unite in one point.

Theſe ſimple experiments cannot be accounted for upon any other principle than that which I have already advanced on the nature of viſion; namely, that all objects, as they recede from the eye, are ſeen under a ſmaller angle in proportion to the diſtance of the object from the eye. This propoſition holds good, not only as it relates to the heights of objects, but alſo to their breadth and thickneſs, for theſe are diminiſhed or contracted by the ſame rules, founded on the nature of our ſight. Nor are theſe remarks to be reſtricted to ſuch objects as ſtand upright on the ground, for thoſe which are horizontal in their poſition, or which are lying in various ſituations on the ground, are all ſubject to the ſame laws of diminution. But it muſt here be obſerved, that the various poſitions of objects give birth to moſt of thoſe imaginary planes which are introduced into the ſubject of perſpective; for in theſe planes all the variety of objects that we can conceive of, are ſuppoſed to be ſituated, ſome in the ground-plane, and others parallel to it, both above and below the horizon; ſome in upright, and ſome in oblique or inclining planes. And this variety of planes ſhould be under-

ſtood

ſtood and carefully diſtinguiſhed by the learner, before he can make any good progreſs in the art, or know what he is about, when he begins to repreſent.

Theſe planes are again bounded by ſo many right lines, of which they are compoſed; and theſe lines have their names, anſwering to their intended uſe in the practice of perſpective.

Since, therefore, planes, lines, and points, comprehend the whole art of perſpective, it will be requiſite to define theſe in as clear a manner as poſſible. The reader will, perhaps, imagine here, that I am drawing him into the ſtudy of geometry, as an eſſential requiſite to the practice of perſpective, and thereby contradicting what I have already advanced in the preface. If, indeed, to exerciſe our reaſoning faculties, and to make uſe of a little common ſenſe, be termed the ſtudy or knowledge of geometry, I will aver that no man will ever learn perſpective without theſe. But, this every one knows; that many can exerciſe both good ſenſe and reaſon who never ſaw nor heard of Euclid.

Beſides, if the reader has attended to the firſt part of this work, in which lines, ſuperficies, and ſolids, have been touched on in a general way, he cannot be conſidered as totally ignorant

of ſome part of geometry which is uſeful to the knowledge of perſpective; however, as I have ſaid nothing of planes and their interſections, I ſhall here explain them, ſo far as they relate to the ſubject of perſpective.

Of the Nature of Planes relative to the Subject of Perſpective.

A plane, ſtrictly ſpeaking, is an even ſurface, neither concave nor convex, but which will agree with a ſtraight ruler or line every where.

A plane, in theory, may be conſidered indefinitely, or definitely. When it is ſuppoſed to be indefinite, it admits of no bounding lines, but is imagined to be continued without limits.

When it is defined, its boundaries are limited by lines, as A B, B O, O D, and D A. Fig. 2.

In perſpective there are five planes principally in uſe, according to Dr. Brook Taylor's ſyſtem; but the various circumſtances of objects in the picture frequently produce a variety of others, which, however, are not termed the elementary planes, as the above five may, but only accidental, depending on the circumſtances of objects.

Of the Ground Plane.

In the order of theſe planes I ſhall conſider the ground plane firſt, being commonly a horizontal ſurface on which original objects have, in general, their ſeats or foundations; as 1, 2, 3, 8, is the ſeat of the caſe of drawers on the ground plane A B, D O, Fig. 2.

The Doctor terms the ground plane the original plane, "By which," he ſays, "we mean the plane wherein is ſituated any original point, line, or plain figure." I ſhall, in general, however, uſe the term ground plane, as being more ſimple, except in caſes where no regard is paid to its being horizontal; then, indeed, the term original plane muſt be uſed, being more comprehenſive, as it includes any poſition.

Of the Perſpective Plane.

Second, the perſpective plane, otherwiſe called the plane of the picture; which, in general, is a plane perpendicular to that of the ground, as G R, H L.

This plane is to perſpective what the retina is to optics; for the images of all original objects are delineated on both.

The

The perſpective plane may be conſidered as ſome tranſparent medium placed upright between the object we view and our eye; and as the rays of light coming from every point of illumined objects converge, in right-lined directions, to a point on the pupil P, Fig. 2, a ſection of thoſe rays, produced by this tranſparent medium or perſpective plane, is the perſpective repreſentation of the original object, be it what it may.

Hence, let the learner place himſelf before a glaſs window, which is, properly ſpeaking, the perſpective plane to every object he looks at through it; and as thoſe objects appear to him on the window, ſuch is their perſpective repreſentations on the paper, board, or canvaſs, we draw on. The appearance of objects on a window may be found by gumming the glaſs, which does not deſtroy its tranſparency, but makes it capable of receiving a mark; and if the eye be kept perfectly ſteady to one point in the window, and, with a pencil, the points or angles of a houſe, for inſtance, be marked as they appear on the glaſs; and when this is done, if right lines be drawn to each point, theſe lines will form the perſpective of the houſe.

Thus the plane GR, HL, may be conſidered a piece of gummed glaſs fixed upright on a table or ground AB, DO; and at P is the ſpectator's eye, viewing through the glaſs the original object 1, 3, 5, 7. The right lines iſſuing from every part of the object and converging at P, repreſent the rays of

light paſſing through the tranſparent medium to the eye P. Now, as the original object is deſcribed on the glaſs by the direction of theſe rays, if the ſpectator, with his hand, mark the points 1, 3—5, 7, 4—6, and afterwards join the points by right lines, this will be the exact perſpective repreſentation of the original object.

Simple experiments of this ſort ſhould be practiſed, as I am perſuaded they are more calculated to teach the principles of the art than long and tedious theories *.

Of the Horizontal Plane.

THE horizontal plane, or plane of the horizon, is, in perſpective, an imaginary plane paſſing through the eye of the

* An artiſt lately informed me, that a piece of ground glaſs, unpoliſhed, and oiled over with ſweet oil, is the beſt for this purpoſe; for the oil gives a degree of tranſparency to the glaſs that admits of objects being ſeen through it, and its artificial roughneſs makes it eaſy to draw on. If a ſquare of glaſs of this ſort be put in a ſlight frame of wood, fixed upright on a plain board, and there be a ſight-hole made in a piece of wood fixed perpendicular to the ſquare of glaſs; and if the ſight-hole be fixed from the glaſs equal to the diſtance P *s*, and to the height of the eye P N, then every thing which relates to Fig. 2, may be proved by ocular demonſtration, provided the learner uſe this little inſtrument according to the references made to this figure in the different heads of this ſection.

ſpectator,

ſpectator, and being perfectly parallel with the ground plane, it cuts the upright picture or perſpective plane at right angles.

Thus, in Fig. 2, Plate XIV. F H, L M, is the horizontal plane, whoſe perpendicular height from the ground plane A B O D is the height of the eye at P; hence P N is the perpendicular height of the eye, becauſe the line P N is perpendicular to both theſe planes.

The horizontal plane F H, L M, being produced, it neceſſarily cuts the perſpective plane G H, L R, at right angles, and the interſection of theſe two even ſurfaces or planes with each other being a right line as H L; hence we have what is commonly called the horizontal line H L; or, more properly, the vaniſhing line of a plane parallel with its original. And as the interſection of the horizontal with the perſpective plane produces the vaniſhing line H L, ſo the interſection of the picture with the ground plane produces the baſe or ground line G R.

All original objects, as they appear to come into the plane of the horizon, gradually vaniſh into a point, and diſappear. Hence the application and uſe of the term horizon in perſpective, which literally means the limits or boundaries of our ſight, from "ὁριζω, *horizo*, I limit or bound." The further objects are repreſented from the front of the picture, or from the

ground

ground line G R, the nearer is their approach to this plane, and conſequently their apparent magnitude will be proportionably leſs, as has been already demonſtrated in page 183. For if the caſe of drawers, in Fig. 2. were removed conſiderably further from the perſpective plane G R H L, it is evident that the rays 1 P, 3 P, 5 P, 7 P, &c. would not ſubtend * ſo large an angle on the plane of the picture as they do at preſent: it is alſo manifeſt that theſe rays will alſo riſe higher on the picture in proportion as the caſe of drawers or original object is removed back, conſequently the image 1, 3, 5, 7, of the drawers on the picture would approach nearer to the horizontal plane, until at length the image on the picture would totally vaniſh at *s*, the center of the picture and height of the eye.

To underſtand this yet more clearly; ſuppoſe the drawers to be brought forward cloſe to the picture, then the foot 1 would be at 10, and the foot 3 at 12, on the interſection or ground line G R, and the image of the original object would then appear as large on the picture as the original itſelf; for then the point 5 on the drawers would be at *a* on the picture, and the point 7 at *b*; but the whole image of the original, in this caſe, is lower on the picture than before, and conſequently farther from the horizontal plane, which was to be ſhewn.

* From *ſub* and *tendo*, I ſtretch. The ſubtenſe of an angle coincides with the chord of the arch. Thus the object B D, Fig. 1, ſubtends an angle of 60°, for the rays B P D P cut the arch in that proportion; and therefore the object B D is ſaid to be ſeen under an angle of 60°.

From what has been ſaid, it is obvious that the whole ſpace on the plane of the picture for delineating objects, is comprehended between the ground line G R and the horizontal or vaniſhing line H L. No object can with propriety have its ſeat on the picture below the line G R, for this line is the interſection of the ground plane with the plane of the picture; and therefore, to repreſent the caſe of drawers lower than at 10 and 12 on the ground line G R, would lead us to ſuppoſe a new ground plane below the firſt, and a new horizon to ſuit it, otherwiſe the drawing would be unnatural and diſtorted.

On the other hand, no original object can have its ſeat in the perſpective plane higher than H L, for the line H L marks out the interſection of the horizontal with the perſpective plane; and as the plane of the horizon is generally the vaniſhing plane of all original objects ſituated on the ground, their ſeats in the picture cannot be above the vaniſhing line H L, without producing worſe effects than in the other caſe juſt mentioned. For if the images of all original objects, however large, vaniſh into a point *s* in the vaniſhing line H L, it would be prepoſterous to ſee a tall object ſeated on this line, or above it.

Before I quit this head, it will be proper to obſerve, that the horizontal plane, on which I have ſeemingly laid ſo much ſtreſs, does not poſſeſs any thing peculiar to itſelf, owing

to its being conſidered a plane, perfectly level; for all the various poſitions of vaniſhing planes make no difference in theory, provided they are conſidered as parallels to original planes. It is the poſition that theſe planes have to each other that is to be regarded. This was one principal diſcovery which Dr. Brook Taylor made in his new ſyſtem of perſpective, and which has rendered his principles ſo univerſal. In his book he ſays, "He makes no difference between the plane of the horizon and any other plane whatſoever; for ſince planes, as planes, are alike in geometry, it is moſt proper to conſider them as ſo, and to explain their properties in general, leaving the artiſt himſelf to apply them." Yet it may be obſerved, that we have a natural prejudice in favour of ſomething peculiar to the horizontal vaniſhing plane; becauſe, in nature, the laws of gravity ſettle all ſolid bodies in a horizontal poſition: this being the caſe, we are accuſtomed to view objects in this form, and of courſe are required to draw them ſo; therefore, in the practice of perſpective, the horizontal vaniſhing plane is generally wanted; but in principle and theory, the relation that one plane has to another is only to be regarded.

Of the Directing Plane.

THE directing plane is imagined to be parallel with the picture, whatever poſition it is ſuppoſed to be in; and its diſtance from the plane of the picture is equal to the diſtance of the eye of the ſpectator; therefore it is conſidered as a plane paſſing through the eye, as the plane M F V U, Fig. 2. Hence, if any original line Z X be produced till it cut the directing plane M F V U, a line drawn from Y, where it interſects, to P, the place of the eye is termed the directing line of that original line Z X.

And the repreſentation of any original line in the plane of the picture is always parallel with its directing line in the directing plane.

Of the Vertical Plane.

IN perſpective, the vertical plane is conſidered as perpendicular both to the ground plane and the plane of the picture; conſequently it cuts the other four at right angles. The plane P ſ Q N,

PsQN, Fig. 2, is thus termed geometrically, becauſe it is in a direction perpendicular to the horizon; but in perſpective it may be in any poſition, provided it be perpendicular to the original and perſpective planes, and at right angles with the other.

The interſection of this plane with the picture HLGR produces the perpendicular line *s* Q, termed the vertical line of the picture; and the vertical plane being continued till it cut the directing plane in the line PN, that line PN is the interſection of the vertical with the directing plane; and as *s* Q, the vertical line of the picture, is parallel with PN the interſection of the vertical with the directing plane: PN is therefore the directing line of *s* Q, the vertical line of the picture.

Vertical planes have vertical vaniſhing lines when the picture is perpendicular to the ground plane; in which caſe the vertical line *s* Q is continued to a length above and below the horizon HL, that will admit the neceſſary vaniſhing points.

Of the Viſual Plane.

To theſe planes already deſcribed may be added the radial or viſual planes.

A viſual or radial plane, is ſuch as paſſes through the eye, and any original line whatever.

A plane may be continued by any three points. The three points P X Y are the interſections of three right lines; and, according to geometrical reaſoning, when three ſuch lines meet each other, as the lines P X, X Y, and Y P, they are all in the ſame plane. This, among geometricians, is an axiom or ſelf-evident truth, and therefore needs no demonſtration.

The continuation of the plane P C Y X, which the triangle Y P X is in, till it interſects with the plane of the picture, is therefore the viſual or radial plane of the original line Z X; and the line *v* 16, produced by the interſection of the viſual plane with the plane of the picture, is termed the viſual line of the original Z X.

As I have already obſerved and proved that the appearance of objects on the retina is conveyed by rays of light flowing

ing from every point of any object to the eye in right-lined directions, see page 184; let the right lines X P, Z P, be considered as the rays of light coming from the original object Z X, and converging at P; but these rays are cut or intersected by the plane of the picture G R H L at *x z*, therefore the line *x z* is the projection of the original object Z X on the plane of the picture; or, in other words, it is the perspective representation of the original object Z X: for the representation *x z* of the original line Z X is in the line *v* 16, which is the intersection of the visual plane P C Y X with the plane of the picture: and since the line P C is the parallel of the original line Y X, where P C cuts the plane of the picture at *v*, proves that the line *v* 16 is the true line of intersection produced by the visual plane cutting the plane of the picture. Hence the line *v* 16 is, in perspective, termed the visual line, from *visio*, I see; for the lines P Z, P X, are the rays of light by which vision is performed, or by which we perceive objects, and as the intersection of those rays is in the line *v* 16, so this line *v* 16, drawn on the picture, is properly termed the visual line of its original Z X.

Of the Lines in Perſpective generated or produced by the foregoing Planes.

I HAVE already ſpoken of theſe lines in the explanation of the ſeveral planes to which they are related; but it will alſo be requiſite to ſum them up here, that the learner may have a more clear view of them from what has been ſaid.

Firſt.—The ground line G R, is a line produced by the interſection of the picture or perſpective plane H L G R with the original plane A B D O. It may alſo be ſimply termed the interſection of the picture; but ſome chooſe to call it the entering line.

Second.—The vaniſhing line H L, commonly called the horizontal line, is produced by the interſection of the vaniſhing plane F H M L with the plane of the picture H L G R.

Third.—The parallel of the eye F M, is a line produced by the interſection of the vaniſhing plane with the directing plane U V F M; and as this line is the interſection of a plane paſſing through the eye always parallel to the picture, conſequently

F M

FM is always parallel to the vaniſhing line HL, and of equal height to it.

Fourth.—The directing line UV is the interſection of any original plane ABDO with the directing plane UVFM.

Fifth.—The vertical line Q*s* paſſing through the center of the picture *s*, is the interſection of the verticle or upright plane PN*s*Q with the plane of the picture; and PN, the perpendicular height of the eye, is the interſection of the vertical with the directing plane.

Sixth.—The viſual line *v* 16, is produced by the interſection of the viſual plane PYCX with the plane of the picture, and is therefore the indefinite repreſentation of the original ZX.

Seventh.—The director of an original line. If any original ZX be produced till it cut the directing plane UVFM, a line PY is termed the director of that original line ZX.

Eighth.—The radial line*, or parallel of any original line ZX. In whatever degree of obliquity the original line ZX interſects the ground line GR, in the ſame degree of inclination

* Radial, from ῥαβδος, *rabdos*, or *radius*, a ray of light.

will the radial P v cut the vaniſhing line H L; for P v is parallel to the original line Z X.

Of Points, in Perſpective, produced by the Interſections of the preceding Lines.

As the interſections of planes with each other generate or produce lines, ſo alſo lines meeting or cutting each other produce points.

Hence the following points in perſpective are produced by the interſections of the lines which we have now defined.

Firſt, the point of ſight, or the place of the eye; P is that point where the ſpectator's eye ought to be placed in viewing the picture. Hence, if through the eye P a line perpendicular to the original plane be produced till it cut the parallel of the eye F M, their point of interſection is the point of ſight P.

Second, the center of the picture. If from the point of ſight P a line be drawn perpendicular to the picture, and be produced till it cut the vaniſhing line H L, their interſection will be the point s, or that point termed the center of the picture;

ture; and the diſtance between the point of ſight P, and *s*, the center of the picture, is called the diſtance of the picture; and the line itſelf which meaſures this diſtance, may be termed the direct radial.

Third, the vaniſhing point. If, from the point of ſight P, a line be drawn parallel to any original Z X, and is produced till it cut the vaniſhing line H L, their point of interſection *v* is the vaniſhing point of the original line Z X; becauſe, if the original line Z X were infinitely produced on the ground plane A B D O, its image Z X on the picture would at length vaniſh or diſappear to the eye P in the point *v*. The line which meaſures the diſtance between *v* and P, is the diſtance of that vaniſhing point *v*; and the line itſelf may be termed the oblique radial, becauſe its original Z X is oblique to the picture.

Fourth, the point of interſection. If the original line Z X be produced till it cut the ground line G R, that point 16 where the line G R is cut, is called the point of interſection: and if the original line Z X be ſtill continued till it cut the directing line U V, the point Y, where they interſect, is termed the direct-point of that original Z X.

Laſtly, The point of ſtation. If from the place of the eye P, a line be drawn perpendicular to the ground plane

at N, that point N is the point of ſtation, or foot of the ſpectator.

I ſhall conclude this ſection with adviſing the reader to make himſelf well acquainted with the preceding planes, lines, and points, before he proceed further: which, if he do, it will enable him to read the ſubſequent pages more eaſily, and often prevent the trouble of referring to the plates. Add to this, it will make him underſtand more readily the problems and operations of both this and other publications on the ſubject.

SECTION II.

The Affinity and Agreement between Optical Laws and the Principles of Perſpective demonſtrated—And alſo of the Uſe of the three principal Elementary Planes in the Practice of Drawing—ſhowing, that all that is exhibited by the natural Poſitions of theſe Planes in Fig. 2, may be correctly drawn on any even Surface without their Aid.—Of the various Poſitions of Lines and Planes to the Picture, and of the Principles of Vaniſhing Points agreeing therewith.

Of the Affinity of Optical Laws with the Principles of Perſpective.

In Section I. page 183, it has been ſhown that all objects appear proportionably leſs as they are farther removed from the eye; and as the reader is now ſuppoſed to be acquainted with the planes, lines, points, and terms, which have been explained in the preceding ſection, I ſhall proceed to ſhow that the rules of perſpective agree with optical laws.

Thus:

Thus: let G R, Fig. 4, be the ground line, and H L the horizontal or vaniſhing line, whoſe height above the ground line is equal to that of the eye of the ſpectator; *s* is the center of the picture, and *s* D the diſtance of the ſpectator's eye from the object *b d*. Draw *d b* perpendicular and equal to B D, Fig. 1, and as much to the right hand of *s* as D, in Fig. 1, is to *e*. Then, in Fig. 4, draw the viſual lines *d s* and *b s*; which lines are to determine the heights of the two original objects, E C, F G, in Fig. 1. Then take the ſpaces D C, C G, from Fig. 1, and transfer them to Fig. 4, from *a* to *a*, and from *a* to *n*, on the ground line G R. Draw the lines *a*, D, *n* D, cutting the viſual line *d s* in *g c*; and laſtly, from *g* and *e* on the viſual *s d*, raiſe perpendiculars to *s b*; then will *g*, *f*, *c*, *e* be the perſpective repreſentations of G F and C B in Fig. 1.

The analogy between the two figures will appear as follows.—In optics, P, in Fig. 1, is the pupil, and P *e* the direct radial or axis of the eye, and equal to the diſtance of the firſt object D B from the eye. In perſpective, D, in Fig. 4, is the ſame as P in optics, Fig. 1; and, in Fig. 4, *s*, the center of the picture in perſpective, is the ſame as *e* in Fig. 1. Therefore as P *e* in optics is the direct ray, and the diſtance of the firſt object D B from the pupil P, ſo *s* D, Fig. 4, in perſpective, is the diſtance of the ſpectator's eye from the picture. In optics, if the ſecond object C E is removed twice as far from the eye P as the firſt

object D B is, its image *m v*, on the retina, will be little more than half the length of the image *t n* of the firſt object D B on the retina; and, in perſpective, Fig. 4, the repreſentation *c e* of the ſecond object C E, is exactly half the length of the firſt object D B, as Fig. 4 demonſtrates, and which coincides with Fig. 1; for obſerve, the rays of light P E, P C, coming from the ſecond object to the pupil P, cut D B, their ſection, in the ſame proportion as the viſual lines *s d*, *s b*, of Fig. 4, cut the perpendicular *c e*. Hence the ſpace 2, 7, on D B, is equal to the repreſentation *c e*, Fig. 4; and in the ſame manner the ſpace 1, 8, where the rays of light from F G cut the picture D B, is equal to *g*, *f*, Fig. 4, the repreſentation of G F, Fig. 1.

Laſtly, the repreſentations *g f*, *c e*, in Fig. 4, approach to the center *s*, in the ſame proportion as their originals G F, C E, in Fig. 1, approach to *e*, the center of the imaginary plane B D, which is ſuppoſed to cut the rays of light P C, P G, at 2, 1; for the ſpace D 2 and 1 on Fig. 1, is the ſame and equal to *d*, 2, 1, on Fig. 4; ſo alſo is *d*, *e*, Fig. 4, to D *e*, Fig. 1. And hence it may be concluded, that the rays P C, P G, are to their ſection D *e*, Fig. 1, as the viſual line *d s* is to its dividers or meaſuring-lines D *a*, D *n*, Fig. 4.

Before I conclude this head, it will be proper to obſerve, that notwithſtanding the general agreement between optical

laws

laws and the rules of perſpective, yet in one reſpect there is a difference, for the perſpective repreſentation of any object on a plane, is not the ſame exactly with the appearance of that object to the eye; and therefore, in alluſion to this difference, I have, in the preceding page, already ſaid, "In optics, if the ſecond object C E is removed twice as far from the eye P, Fig. 1, as the firſt object D B is, its image *m v* on the retina will be little more than half the length of the image *t n* of the firſt object D B; but the repreſentation 2, 7, of C E on a plane D B, which is the ſection of the rays P C, P E, is only half the length of the firſt object D B, as the figure itſelf demonſtrates." The reaſon of this difference is owing to the eye being a ſphere, but a picture a level ſurface or plane; for the rays P C, P D, cut the arch or ſphere K L at 6, 5, in a different proportion to what they do on the plane B D, as is plain; becauſe the ſpace D 2, which is the repreſentation of the ſpace D C on the plane B D, is greater than the ſpace 6, 5, on the ſphere K L; which ſpace 6, 5, is the appearance of the ſpace D C to the eye; but the ſpace D 2 is its repreſentation on the picture. This difference, however, decreaſes the further the object is removed from the eye, for then the rays do not cut the picture ſo obliquely; conſequently the repreſentation of the original object on the plane of the picture is more natural, becauſe it has more of the appearance of that real object to the eye. Thus: if the object E C be removed back to F G, the rays P G, P F, are leſs

oblique

oblique to the picture B D; and therefore the repreſentation 1, 8, on the picture B D, is nearer to its true appearance *o b* on the arch K L, than the repreſentation 2, 7, is to its true appearance 5, 11, on that arch; but much more does this difference appear between the firſt object B D and its real appearance *y*, 60, on the arch K L, which yet would be conſiderably more if P were removed to Z. Hence the neceſſity of chooſing a proper diſtance for the repreſentations of objects on a picture, that their appearance on the picture may be nearly the ſame as the real objects have to the eye. This will be touched on in its proper place.

The difference then between the repreſentation of objects on a plane and their appearance to the eye, which is a circle, is as the difference of the tangent of the arch, which comprehends the angle under which the object is ſeen, is to the ſubtenſe of that angle. Thus: let D C be the object viewed at P, then will 6, 5, on the arch KL, be the opening or ſubtenſe of the angle under which the object D C is ſeen, which meaſures fourteen degrees; and D 2, the repreſentation of DC on the plane BD, is the tangent of that arch 6, 5, which comprehends the angle under which D C, the object, is ſeen.

From what has been ſaid on this ſubject, it is evident that a perfect picture of objects, as they appear to the human eye, cannot be delineated on a plane. It may be done on the ſurface of a ſphere, when the eye of the ſpectator is ſuppoſed to be in its center; for then every part of the picture would be equidiſtant from the eye, and every ray of light perpendicular to its own ſurface, as are the rays *y* P, 11, P, &c. of the ſphere K L. None of the rays, in this caſe, could cut the picture obliquely, and conſequently no diſtortion would appear. But though this be the caſe, yet it will not afford any ſolid objection to the certainty of perſpective rules adjuſted to a plane; for, by the help of light and ſhadow applied in different degrees of ſtrength to objects as they are more or leſs remote from the eye, and by a judicious choice of the diſtance, a picture may be drawn on an even ſurface, ſo as to deceive the eye, and produce in the mind ſimilar effects with the original or real objects.

*Of the Uſe of the three principal * Elementary Planes in the Practice of Drawing—alſo ſhewing that every thing exhibited by the natural Poſitions of theſe Planes in Fig. 2, may be drawn on an even Surface without their Aid.*

It is not always underſtood, even by thoſe who have ſome general notions of perſpective, how it is that theſe planes anſwer to a level ſurface, ſuch as the paper we draw on; but, until there be ſome conception of this, I will venture to ſay that perſpective can never be clearly comprehended. Therefore, that the reader may have a clear view of this matter, I ſhall refer him to Fig. 5, Plate XV. in which are ſhewn ſimilar letters and numerals, correſponding with the ſimilar planes, lines, and points of Fig. 2, as follows:

The plane GOBR, Fig. 5, is the original or ground plane GOBR, Fig. 2; alſo the plane GHLR, Fig. 5, is the perſpec-

* Elementary, "from the Latin *elementum*," the firſt rudiments or principles of any ſcience. Hence, in perſpective, the ground plane, the plane of the picture, and the vaniſhing plane, are conſidered as the three chief elementary planes; becauſe the firſt principles of the art muſt be derived from them. The vertical, directing, and viſual planes, are alſo termed elementary, as has been ſhewn in the firſt ſection, but not ſo eſſential in practice.

tive plane denoted by the ſimilar letters in Fig. 2; and the plane F H L M, Fig. 5, is the vaniſhing plane F H L M, Fig. 2.

If, in Fig. 2, a line be extended from P to *s*, from *s* to Q, and from Q to U, that line will meaſure the length of all the three planes in Fig. 5, as from P to U. Thus the ground plane, the perſpective plane, and vaniſhing plane of Fig. 2, are ſuppoſed to be ſtretched out of their natural poſition till they become an even ſurface, as in Fig. 5. The line G R, in Fig. 5, is therefore the interſection of the picture with its original plane, as in Fig. 2; and the line H L, Fig. 5, is the vaniſhing line, produced by the interſection of the vaniſhing plane with the plane of the picture, Fig. 2. The line F M, Fig. 5, is the parallel of the eye, denoted by theſe letters in Fig. 2. And laſtly, Q *s*, Fig. 5, is the vertical line Q *s*, Fig. 2, which is produced to P, in Fig. 5; on which is placed the diſtance P *s* of the ſpectator's eye from the picture, as P *s*, Fig. 2.

Theſe things being underſtood, proceed to draw the plan of the caſe of drawers on the ground plane G O B R. Thus: from Fig. 2, take the ſpace Q T, equal to the diſtance which the drawers are placed from the picture. Transfer this ſpace to Fig. 5, from Q to *t*, and draw the line 1, 3, parallel to G R; becauſe 1, 3, in Fig. 2, is parallel to the plane of the picture. Ex-

tend the compaſſes from 1 to 3, and from T to *w*, of Fig. 2, for the length and breadth of the drawers, and make the plan on Fig. 5, the ſame.

In Fig. 5 produce the line 8, 3, and 2, 1, to G R, at the points 10 and 12, anſwerable to 10 and 12, Fig. 2. Draw then the viſuals 10, *s*, 12, *s*, Fig. 5, correſponding with 10, *s*, 12, *s*, Fig. 2, on the plane of the picture. Take then, from Fig. 2, the perpendicular height T *y* of the drawers, and place this from 10 to *b*, and from 12 to *a*, Fig. 5. Draw then the viſuals *b s*, *a s*, anſwerable to the ſame letters in Fig. 2. Next, from the points 1, 3, 8, 2, draw lines tending to the point P, which will cut the viſual lines at 1, 3, in the ſame manner as the rays 1, P, 3, P, cut the viſuals 10, *s*, 12, *s*, at 1, 3, Fig. 2.

In Fig. 5, from 1, 3, raiſe the perpendiculars 1, 5, 3, 7, cutting the viſuals *b*, *s*, *a*, *s*, at 7, 5, in like manner as the rays 5, P, 7, P, Fig. 2, cut the points 5, 7, on the plane of the picture. Draw then from 7 to 5, Fig. 5, a line parallel to 1, 3, which will determine the height of the drawers; and for the apparent breadth of the top, raiſe a perpendicular *g*, 6, from *g*, the point where the line 8, P, cuts the viſual 10, *s*, and the point 6 will determine the apparent breadth of the drawers; in the ſame manner as the rays P, 4, P, 6, cutting the viſuals *a*, *s*, *b*, *s*,

at

at the points 6, 4, determine the repreſentation of the top of the drawers 5, 7, 6, 4, at the correſponding points on the plane of the picture, Fig. 2.

By theſe operations it is manifeſt that the repreſentation of the drawers in Fig. 5, where the planes are ſtretched out till they become an even ſurface, is the ſame in all its parts as the image or repreſentation of the caſe of drawers on the plane of the picture Fig. 2, where all the planes are in their natural poſitions. This would follow from a proceſs of geometrical reaſoning; but, perhaps, it would be too tedious to the reader, and a deviation from the profeſſed plan of this treatiſe; and, therefore, I ſhall only recommend to him, to apply the compaſſes to each repreſentation in the different figures, by which he will perceive the equality of parts in both; and, if to this be added a little reflection on the preceding operations, I have not the leaſt doubt of its being underſtood.

Of the various Poſitions of Lines and Planes to the Picture, and to the Ground Plane—alſo of their Repreſentation on the Picture agreeing therewith, and of their various Modes of Vaniſhing.

THE original line Z X, in Fig. 2, is oblique to the picture, and is therefore treated in a diverſe manner from the lines in the cheſt of drawers, which are all either parallel and perpendicular to the picture, or parallel to the ground plane and perpendicular to it.

Caſe 1.—When any line 1, 3, Fig. 2, is parallel to the picture and to the ground line G R, its repreſentation is parallel alſo. This is ſelf-evident by inſpecting the figure.

Caſe 2.—Lines in the aforeſaid poſitions can have no vaniſhing line or point in the picture, becauſe if infinitely produced would never cut it; that is, the lines 1, 3, and G R, Fig. 2, would never meet in a point, however far produced, for lines truly parallel can never cut each other.

Caſe 3.—The repreſentations of lines originally parallel to each other and to the picture, are parallel to one another

on

on the picture. Thus: the lines 1, 3, 5, 7, 4, 6, Fig. 2, are all parallel to each other and to the picture; therefore their repreſentations 1, 3, 5, 7, 4, 6, on the picture, are all parallel to one another, as is ſelf-evident by comparing theſe with their correſponding lines in Fig. 5.

Caſe 4.—If any original line 1, 5, Fig. 2, be perpendicular to the ground plane, its repreſentation will be perpendicular to the ground line G R; wherefore the repreſentation of the original 3, 7, or any other in the like poſition, ſituated any where on the ground plane, is perpendicular to the ground line G R. Hence the correſpondent lines 3, 7, 1, 5, Fig. 5, are drawn perpendicular to G R, the ground line.

From the above theory it may be concluded, that the repreſentation of a geometrical ſquare or parallelogram *, is a geometrical ſquare or parallelogram, if it be ſituated in a plane parallel to the picture. Hence I K, L M, Fig. 6, is the true repreſentation of the original ſquare A D, B C, which is in this poſition.

Caſe 5.—All lines perpendicular to the picture, have their vaniſhing points in the center of the picture.

* See its definition in page 44, and its figure Plate II.

The

The lines 5, 4, 7, 6, of the ends of the drawers, are perpendicular to the picture H L G R; conſequently their repreſentations 5, 4, 7, 6, on the picture, appear to terminate to a point at *ſ*, the center of the picture. Wherefore, in repreſenting the top of the cheſt of drawers at Fig. 5, *b a* is made equal to the length 5, 7, Fig. 2; and from *b a*, Fig. 5, lines are drawn to the center *ſ*.

Hence the repreſentation of a geometrical ſquare, ſituated in any plane perpendicular to the picture, is a trapezoid, as I K, L M, Fig. 6; that is, two of its ſides, I K, M L, are parallel, and the other two, K L, I M, not ſo *.

In whatever poſition an original plane may be in with reſpect to the ground plane, if it be but perpendicular to the picture, the repreſentation of a geometrical ſquare in that plane will ſtill be a trapezoid. If the planes be above or below the horizon, its appearance will be of that figure. Thus, in Fig. 3, *a*, *b*, *o*, *p*, is the repreſentation of a ſquare ſituated in the ground plane, which is certainly perpendicular to the picture, if the picture be perpendicular to the ground; as N *q*, a ſection of the picture, is upright to *q b*, one of the ſides of the ſquare: *c i* is alſo the repreſentation of a ſquare, ſituate in a plane raiſed above the

* See its definition page 44, and its figure Plate II.

ground plane, but parallel with it, and therefore perpendicular to the picture in this caſe; alſo *e f* is the repreſentation of the ſame ſquare, ſituate in the plane of the horizon, which is a plane equal to the height of the eye, as the plane F M H L, Fig. 2. Wherefore in this plane the ſquare does not appear, for it vaniſhes into one right line, as *e* 2. But if thickneſs be attributed to the ſquare, as denoted by the double line, then, by the help of ſhadow, two of its ſides may be ſeen, as *e* 1, 1, 2; but obſerve, both the ſides are in one right line.

The ſquares *g h*, *l k*, are in planes above the horizon, elevated nearly as much as the other two *a b*, *c i*, are below it; their appearances are therefore trapezoids of nearly the ſame dimenſions. And it is alſo evident, ſince all theſe ſquares are ſituate in planes perpendicular to the picture whether above or below the horizon, they muſt have their vaniſhing point in the center of the picture *s*; and, as they are all parallel to the ground plane, their common vaniſhing line will be H L.

Caſe 6.—If a geometrical ſquare be ſituated in a plane inclined in any angle to the ground plane, whether it be above or below the horizon, provided the plane be conſidered perpendicular to the picture, its repreſentation will be, as before, a trapezoid; and likewiſe its vaniſhing point will be in the center of the picture. Thus, in Fig. 8, No. 1, A D B C is the repreſentation of a geometrical ſquare in a plane A E P O, inclined to the ground

plane

plane equal to the angle *n* A D. Now it is evident, that the ſquare will incline to any angle, by ſuppoſing it to revolve on its center A C in the arch *u n k*; for the ſide D B of the ſquare may be preſſed to *t k* or *o u*, or to any point in theſe arches, without altering its poſition to G R, the ground line or ſection of the picture; therefore, wherever the ſide of the ſquare D B is in theſe arches, it will ſtill vaniſh to *s*, the center of the picture; and its appearance will be a trapezoid: for *u o*, D B, *k t*, are all parallel among themſelves, and to *r s*, which is perpendicular to the picture. For the ſame reaſons the other ſquares above the horizon, though inclined to the ground in different degrees, and in different directions, have the ſame vaniſhing point.

Caſe 7.—All lines oblique to the picture, but parallel to the ground plane, have their vaniſhing points ſomewhere in the horizontal line H L, Fig. 2; but not in the center of the picture, as in Caſe 6, when the line is perpendicular to the picture. Alſo if oblique lines are parallel to each other, they all have the ſame vaniſhing point. The original line Z X, in Fig. 2, is oblique to the picture, and its vaniſhing point is at *v* in the vaniſhing line H L, not at *s*, the center of the picture; for a line drawn from the eye P, and produced till it cut the picture at *v*, in a parallel direction to Z X, is the vaniſhing point of that original line Z X. Wherefore, in Fig. 5, where the elementary planes are ſtretched out to an even ſurface, draw the original

Z X inclined to G R, in the angle which it is ſuppoſed to be in to the picture in Fig. 2. Produce X Z till it cut G R at 14 in Fig. 5; then lay the diſtance of the eye from the picture on the vertical line at P, and from P draw P *v* parallel to Z X; then will *v* be the true vaniſhing point to the line Z X, upon the ſame principles that *v*, in Fig. 2, is the vaniſhing point to Z X in that figure.

If a number of lines oblique to the picture be parallel to each other, they will all have the ſame vaniſhing point; for the ſame reaſon as a number of lines perpendicular to the picture have but one vaniſhing point in the center. Therefore, in Fig. 9, Plate XVI. the geometrical ſquare 1, 2, 3, 4, having its ſides oblique to the picture, the ſides which are parallel to each other are drawn to one vaniſhing point. The ſides *d b*, *c a*, are originally parallel to each other, for they are the repreſentations of 2, 3, 1, 4, of the original ſquare, wherefore they vaniſh into one point at *v*. In like manner, and for the ſame reaſon, the ſides *b a*, *d c*, vaniſh at V. It is evident then, that the repreſentation of a ſquare, having its ſides oblique to the picture, is a trapezium *; that is, none of the ſides are parallel to each other.

* See its figure Plate II. and its definition page 45.

Caſe

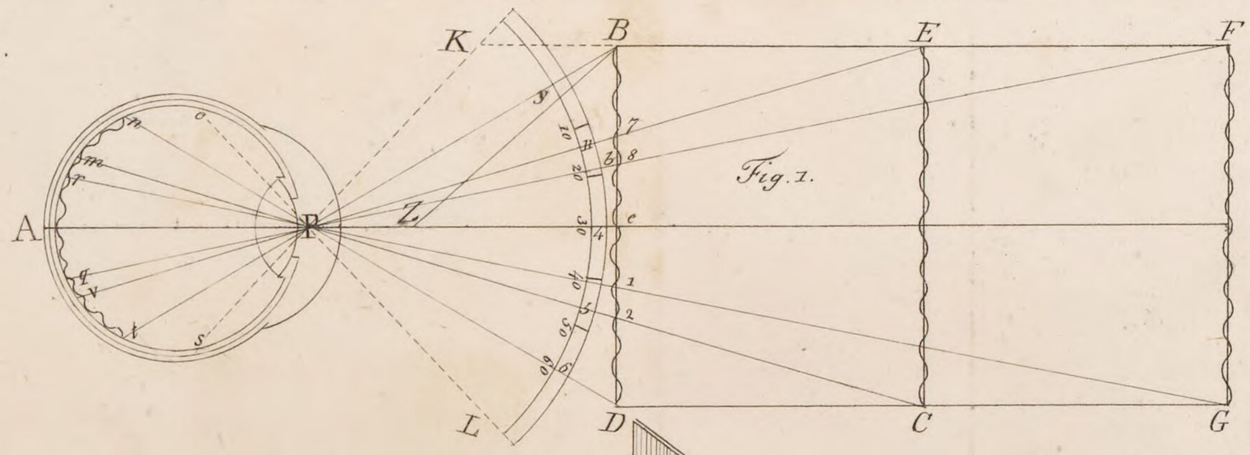


Fig. 1.

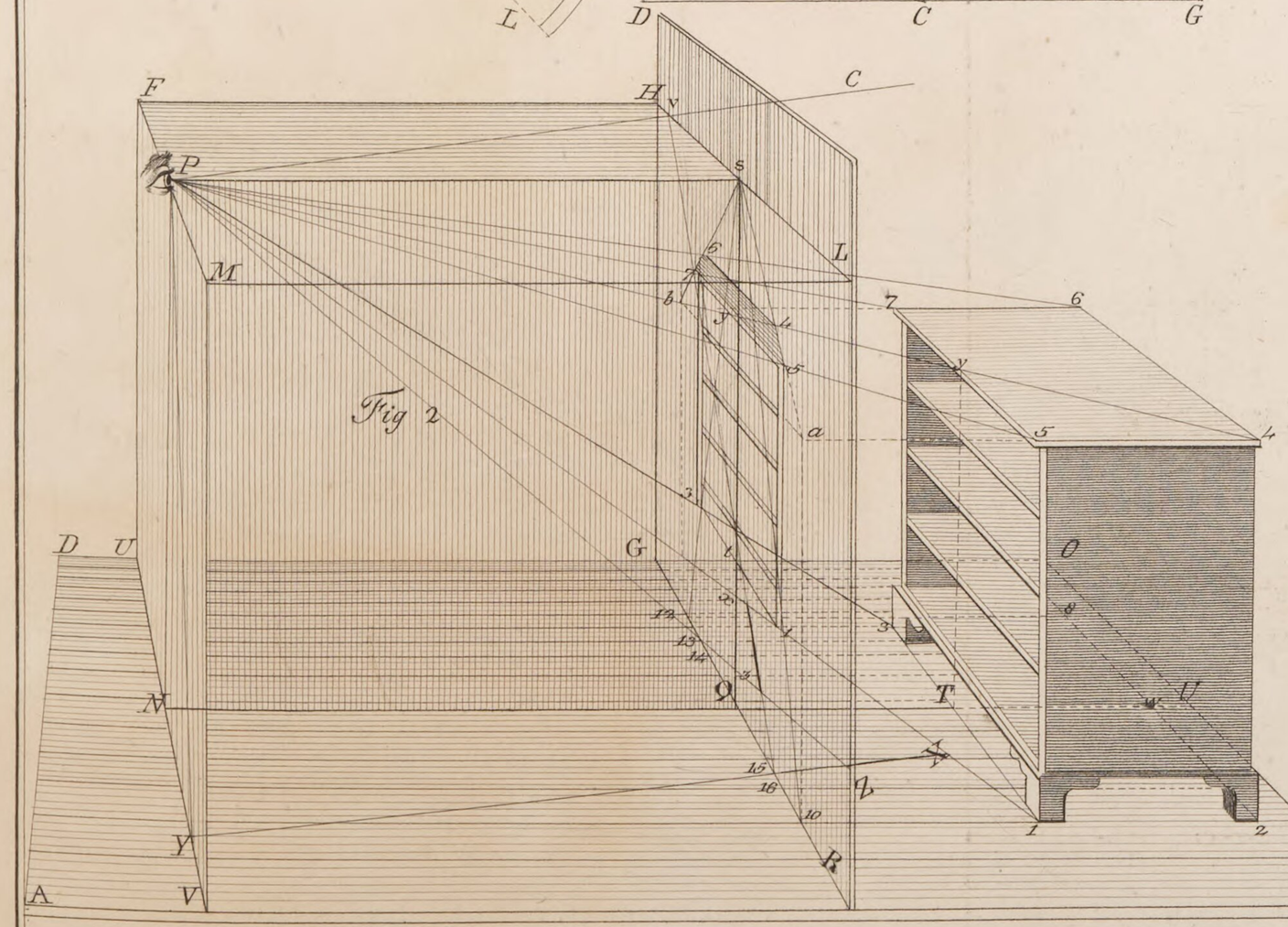


Fig 2

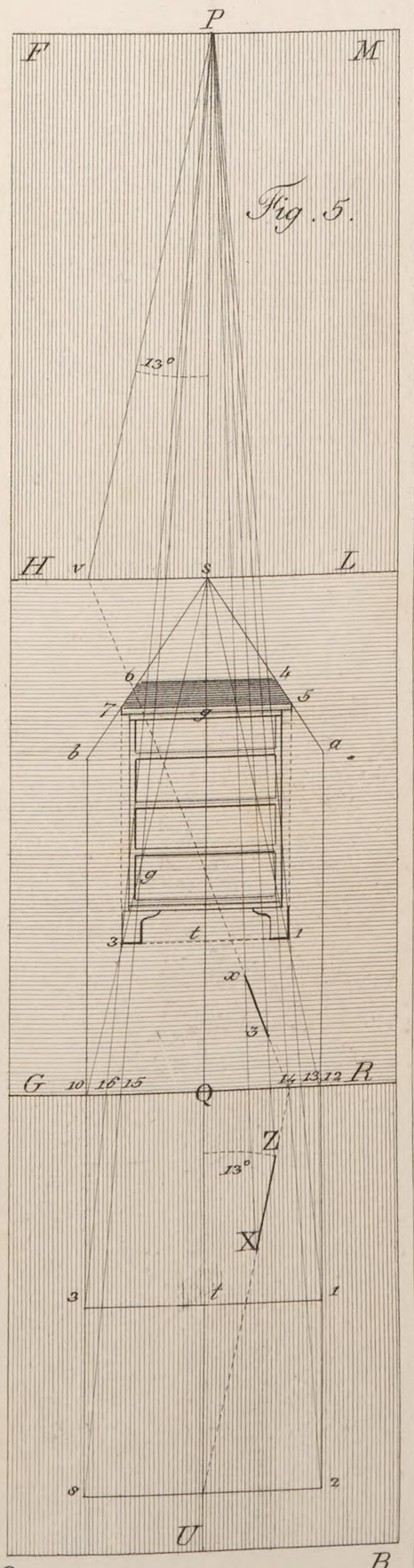


Fig. 5.

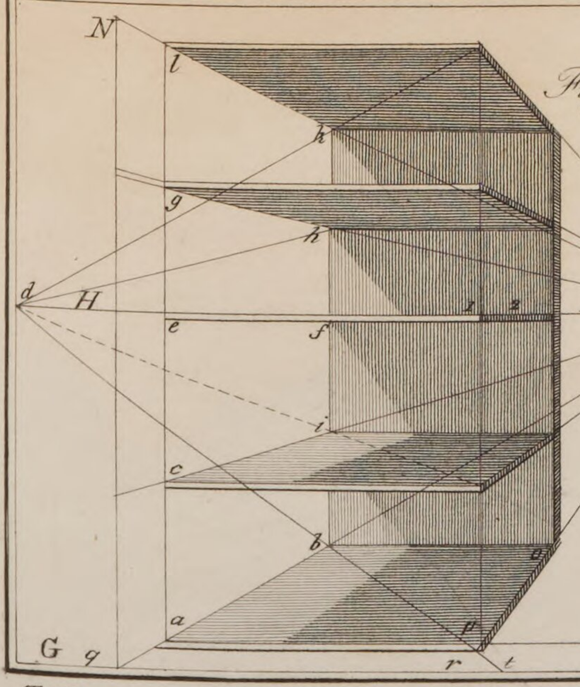


Fig. 3.

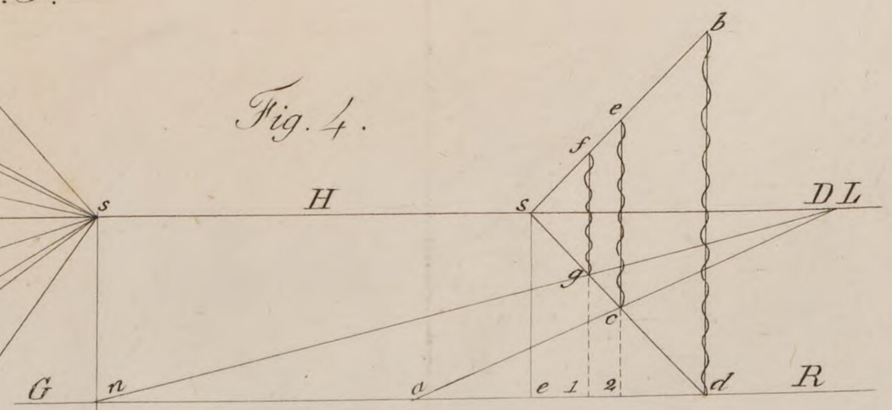


Fig. 4.

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J. Barlow Sculp.

Caſe 8.—When a ſquare is ſituated in a plane perpendicular to the ground, but oblique to the picture, only two of its ſides will vaniſh to a point, as BC, AD, No. 2. The other ſides, AB, DC, can have no vaniſhing point; becauſe they are perpendicular to the ground, and parallel to the picture. See Caſe 2, page 215. Its repreſentation is therefore a trapezoid. And becauſe the ſquare is not perpendicular to the picture, its vaniſhing point is not in the center *s*, but in ſome other point *v* in the horizon, according to the angle which the original ſquare makes with the picture, or with its interſection. Thus MA*i* is the angle which the ſquare AB, DC, makes with the interſection, or ground line GR; or, in other words, it is the original poſition which the ſquare ſtands in to the picture. Hence *vd* being parallel to MA, it forms the ſame angle to the vaniſhing line HL; and being drawn in this direction from the place of the eye *d*, and produced till it cut HL at *v*, conſequently *v* is its vaniſhing point.

Caſe 9.—If a ſquare be ſituated in a plane inclined to the ground plane, and its interſection with the picture be parallel to the interſection of the ground plane with the picture, as AF, No. 3, then the vaniſhing line of that plane will be parallel to the ground line GR; and two of its ſides, AN, FO, may be conſidered as perpendicular to the picture; but the other two

ſides,

ſides, A F, N O, are really parallel, and therefore have no vaniſhing point in the vaniſhing line H L. See Caſe 2, in page 215.

The ſides A N, F O, are conſidered perpendicular to the picture; becauſe, it is evident, that the ſquare may be ſuppoſed to revolve on the ſide A F, and be preſſed or moved to 8, 10; which ſhow the angles of the ſame ſquare in a plane ſtrictly perpendicular to the picture, and therefore its ſides 11, 8, 12, 10, have their vaniſhing point in the center *s*. See Caſe 4, in page 216. Wherefore, as the ſquare may revolve on A F, as a table top hinged at the front, and riſing to any angle from its frame, its vaniſhing point will riſe on the vertical line *s d*, in proportion to that angle. Hence S is the true vaniſhing point of the ſquare A F, N O, making the angle F A 6 with the ground plane.

Caſe 10.—If a ſquare be ſituated in a plane of the above kind, having its ſides oblique to the picture, every thing will be conſidered the ſame as in the foregoing caſe, only the ſides will vaniſh to two points in the horizon; neither of which can be in the center *s*, nor in any part of the vertical line *s d*; becauſe the ſide A B, Fig. 10, of the original ſquare, is not perpendicular to G R. But, as the interſection of this inclined plane with the picture is parallel with the ground plane, as in

Caſe 9, the vaniſhing points will riſe in a perpendicular direction above the common vaniſhing line H L, in proportion to the angle which the inclined plane makes with the ground plane.

Hence *v v* on the new horizontal line *h l*, are placed perpendicular to V V in the common horizon H L; which points V V would be the true vaniſhing points of the original ſquare A B, B C, were it repreſented upon the ordinary ground plane; or, in other words, if it were repreſented in a plane perpendicular to the picture, and parallel to the ground plane.

Caſe 11.—If a ſquare A D B G, Fig. 11, be ſituated in a plane oblique both to the ground plane and to the picture, its vaniſhing line will be in an angle to the common horizon H L, in proportion to the angle which the inclined plane makes with the ground. For, as the original plane in this caſe is inclined both to the ground and to the picture, conſequently its interſection with the picture will be oblique to the interſection of the ground plane with the picture. Caſe 9 has a horizontal vaniſhing line, though it ſuppoſes the original plane to be inclined to the ground; but as its interſection is parallel to the ground line, ſo its vaniſhing line is parallel alſo. In the caſe before us, the original plane has an oblique interſection with

the

the picture, and therefore its vaniſhing line is oblique to the horizon alſo; which, perhaps, may be better underſtood by No. 1, ſhowing the ſame ſquare in the ſame poſition, conſidered as the top of a table viewed angle-ways, whoſe top is ſuppoſed to be riſing on its hinges at A C in the angle *u* A K. Its vaniſhing line is therefore *v* V, found by drawing M V, making an angle with the horizontal line H L, equal *u* A K, the angle which the inclined plane makes with the ground. Or the vaniſhing line may be found as in Fig. 11; by drawing *v* M, cutting O *m*, which is a line perpendicular to the horizon. From the meaſuring point *m*, draw M V parallel to the horizon, cutting V P at V; then will the line *v* V be the true vaniſhing line as before. The line A X is conſidered as the interſection of the inclined plane, and is therefore drawn parallel to *v* V, the vaniſhing line; for, in perſpective, it is a univerſal theorem, according to Dr. Brook Taylor's ſyſtem, that the vaniſhing line, interſection, and directing line of any original plane, are parallel to each other; alſo, "the vaniſhing points of all lines in any original plane, are in the vaniſhing line of that plane." See his Sixth and Seventh Theorems. Wherefore the line A X is to *v* V the vaniſhing line, the ſame as the ground line G R is to the horizontal line H L.

Theſe, and the other lines which I have hitherto paſſed

over

over unnoticed in the various caſes, will be explained in the different problems belonging to each particular caſe, and therefore I deem it unneceſſary to ſay more on them at preſent.

SECTION III.

Containing Problems in Perſpective, ſolved according to the preceding Principles and Caſes—applied to the Methods of drawing rectangular Superficies and Solids in different Poſitions to the Picture.—Alſo, how to draw Viſual Lines, tending to vaniſhing Points, out of the Picture; and how to reduce the Point of Diſtance to any Proportion, ſo as to bring it within the Limits of the Picture.

In the methods of inſtruction generally made uſe of by moſt of thoſe who have written on this ſubject, it is common for them to begin with finding the repreſentations of points and lines, proceeding afterwards to ſuperficies and ſolids.

To me, however, it appears an unneceſſary prolixity, eſpecially it would be ſo to the perſons for whom this treatiſe is chiefly intended. For to go through all the problems neceſſary for points and lines as they may be differently ſituated to the ground plane and picture, and alſo to ſhow how theſe lines are to be meaſured off according to any given length, would take

up as many plates and pages of letter-preſs as would be ſufficient to explain the ſuperficies of figures of which theſe lines are the boundaries.

Beſides, it is preſumed that the general readers of this work will underſtand the various poſitions of lines, and how to meaſure them off, according to their given lengths, better when they are connected with ſome figure, than when theſe ſame lines are conſidered abſtractedly. And, in general, it may be ſaid, that when perſons ſet about drawing, it is not to repreſent a line or a point nakedly, but to draw the perſpective appearance of ſome figure bounded by lines and points; which, when performed, muſt of courſe include every thing requiſite to the repreſenting or meaſuring of a bare line. Therefore, in finding the repreſentation of a geometrical ſquare, for inſtance, the problem for this will teach us both how to find the points of its angles, and at the ſame time how to repreſent and meaſure a line equal to the ſides of the given ſquare, or any other figure of that nature. For theſe reaſons I omit points and lines, and proceed to the firſt problem, which is

PROB.

PROB. I. FIG. 7. Plate XV.

To repreſent a Geometrical Square lying on the Ground, having two of its Sides parallel to the Picture, and the other two perpendicular to it.

OPERATION.—Draw the ground line G R, and draw H L for the vaniſhing line, whoſe height from the ground line is ſuppoſed to be equal to the height of the ſpectator's eye. Make *s* the center, or that point in the picture which is directly oppoſite to the eye when the picture is viewed. Make *d* the diſtance of the eye from the picture, anſwering to P *s*, in Fig. 2, Plate XIV. In this manner the paper or canvaſs we draw on is prepared for delineating objects in the above ſituation.

The next thing to be conſidered, is the ſeat of the object in the picture; that is, how far the ſquare, for inſtance, is to be placed to the right or left of the center *s*, or whether it is to be directly under the center, and how far removed back from the picture. Theſe being fixed on, lay down C A equal to the ſide of the ſquare to be repreſented, and draw the lines C *s*, A *s*, termed viſual lines. Determine then how far the ſquare is to be removed from the picture, which in this example is equal 1 2.

Draw from 2 a line to the point of diſtance *d*, cutting the viſuals C *s*, A *s*, at B and A. Laſtly, from theſe points of interſection at B and A, draw the lines A C, B I, parallel to G R, the ground line, and the repreſentation will be completed as required.

Obſervations.—The ſides C B, A I, of the ſquare, are perpendicular to the picture, and therefore, by Caſe 5, page 216, they muſt vaniſh in *s*, the center of the picture. The ſides C A, B I, are conſequently parallel to G R, the interſection of the picture or ground line; wherefore, by Caſe 1, page 215, they are the repreſentations of original lines parallel to the picture; and being parallel, they can have no vaniſhing point.

Prob. II. Fig. 7. Plate XV.

To find the Repreſentation of a Square perpendicular to the Ground, and alſo to the Picture.

The picture being already prepared in the foregoing problem, the ground line and vaniſhing line remain the ſame; alſo the point of diſtance and the center *s* are the ſame. And it ſhould be obſerved, that G R is the ground line, and H L the horizontal line in every example. Alſo *s* denotes the center of the

the picture, and *d* the diſtance; therefore, in future, the explanation of theſe may be omitted, and we may proceed as follows:

Operation.—Draw the perpendicular A D equal to the ſides of the original ſquare, and draw the viſuals D *s*, A *s*. Then, on the ground line G R, lay on a ſpace from 1 to C equal to the diſtance of the ſquare from the front of the picture. Make C N equal A D, and draw C *d*, N *d*, cutting the viſual A *s* in I and M. Laſtly, from I and M raiſe perpendiculars to K L, and the ſquare will be repreſented as required.

Obſervations.—The ſides I K, M L, are perpendicular to the ground; wherefore, according to Caſe 4, page 216, they are the repreſentations of lines originally perpendicular, as A D; and being perpendicular to the ground, conſequently they are parallel to the picture, and therefore can have no vaniſhing point. But the ſides K L, I M, are perpendicular to the picture; therefore they vaniſh to *s*, the center.

PROB. III. FIG. 6. Plate XV.

To repreſent a Square ſtanding upright on the Ground, but parallel to the Picture.

THE ground line and horizontal line, &c. remaining as in the preceding problem, proceed to the operation. Draw A D B C a geometrical ſquare on the ground line. Draw the viſuals A *s*, D *s*, B *s*, C *s*; then lay on a ſpace A N on the ground line equal to the diſtance which the ſquare is ſuppoſed to be from the picture. Draw N *d* cutting the viſual A *s* in I. From I draw I M parallel to A C. Draw I K, L M, perpendicular to A D, C B. And, laſtly, draw K L parallel to D B; then will the ſquare I K, L M, be the repreſentation of the original ſquare A D B C, as propoſed.

Obſervations.—The viſual rays A *s*, D *s*, B *s*, C *s*, form a pyramid*, whoſe baſe is a geometrical ſquare A D B C, and whoſe vertex is *s*, the center of the picture. If this pyramid have a ſection parallel to its baſe, it muſt be evident to every one, that the ſection will produce a geometrical ſquare. The

* See its definition page 97, and its figure Plate VI.

repreſentation

repreſentation I K L M is a parallel ſection of the pyramid of rays iſſuing from each angle of the original ſquare A D B C, and therefore I K L M, the ſection, is a geometrical ſquare. See the concluſion drawn from Caſe 4, page 216, in which we ſay,— " That the repreſentation of a geometrical ſquare or parallelogram is a geometrical ſquare or parallelogram, if it be ſituated in a plane parallel to the picture."

PROB. IV. FIG. 8. Plate XV.

To repreſent a Square ſituated in a Plane inclined to the Ground, and perpendicular to the Picture.

A O P E may repreſent the inclined plane, which is merely to aſſiſt the imagination, or to convey what is to be underſtood by the ſquare A D B C, No. 1. being in a plane inclined to the ground.

Operation.—On G R, the ground line, draw the ſemicircle *u n k*, whoſe radius muſt be equal to the ſide of the original ſquare. Draw *n* A perpendicular to the ground line; then make *n* A D equal to the angle of inclination which the original ſquare has to the ground. Draw then, as before, the viſuals A *s*, D *s*, to the center *s*. Let *d*, near L, on the common horizontal line

H L, be the diſtance as in common; draw the line *u d* cutting the viſual line A *s* in C. From C draw C B parallel to A D, then will A D C B be the repreſentation of a geometrical ſquare, ſituated in a plane inclined to the ground, in an angle of twenty-three degrees.

Method ſecond.—Let G 1, R 1, be the interſection of the inclined plane with the picture; or, in other words, let it be conſidered as a new ground line, and turn the plate till this line come into the ſame ſituation with the eye as the old ground line G R appeared to be in when the plate was upright. This will make every thing in this ſecond method appear quite plain, I preſume, and will ſhow that it is as eaſy to repreſent a ſquare in a plane inclined in any degree to the ground, if it be perpendicular to the picture, as it is to repreſent one lying on the ground, having two of its ſides perpendicular to the picture. The plate being placed to the eye as above mentioned, draw a new horizontal line *h i*, *l i*, parallel with G 1, R 1, paſſing through the center *s*. Make *s d* on this new horizontal line equal *s d* on the old one H L. From D lay down the ſide of the ſquare D A, and draw the viſuals A *s* and D *s*. From A draw A *d*, cutting the viſual D *s* in B. Make B C parallel to A D, and the repreſentation will be as before. In No. 2 the ſame ſquare is inclined to the other hand; but the operation is ſtill the ſame, when the new ground line G 2, R 2, is drawn, and when a new horizon

horizon, *h* 2, *l* 2, is drawn parallel to it, paſſing through the center *s*, *d* near *h* 2 will then be its diſtance, or *d* near *l* 2 will do, for they are both the ſame to the ſquare No. 2; ſince both the diagonals of the ſquare, if produced, will tend to each point of diſtance, as is evident from inſpection. The ſquares No. 3 and No. 4 are repreſented above the horizon; but as they are conſidered in planes perpendicular to the picture, this makes no difference in their repreſentations, for their perpendicular ſides vaniſh in *s*, the center, and the operation is the ſame above as below the horizon in all reſpects. As I have marked the ground lines and vaniſhing lines to each ſquare, diſtinguiſhing them by the ſame numeral that the ſquares are marked with, I think it unneceſſary to go through the operations, as it would only be repeating what has been ſaid on thoſe below the horizon. See Caſe 6, on Fig. 8, No. 1, in page 219.

Obſervations.—From what has been ſaid on Fig. 8, it is evident that the foregoing problem may be applied to uſeful purpoſes in repreſenting different pieces of furniture; and that which has been frequently done at random, for want of knowing better, may be done with great eaſe and accuracy. For inſtance, the riſing deſks of the library table, Plate XXX, are repreſented by this problem. The two ſemicircles ſhew that the deſk, raiſed to any pitch, will ſtill be within theſe arches,

 which

which are the boundaries of the deſk, as it paſſes round on its hinges.

Prob. V. Fig. 9. Plate XVI.

To repreſent a Square ſituated in a Plane inclined to the Ground and to the Picture, when the Interſection of the inclining Plane is parallel to the Ground Line, or when its Interſection is in the Interſection of the Ground Plane with the Picture.

In this caſe the common ground line G R is the interſection of the inclined plane with the picture; and a line, S P, produced parallel to G R will be the vaniſhing line of this plane.

Operation.—Let H L, the common horizon, be drawn as uſual; and let *s* be the center of the picture. From *s* to *p* is the diſtance of the eye from the picture. Take in the compaſſes, A F, equal to the ſide of the ſquare, and with it ſweep the arch *q r* from *p*; then from *r* to *q*, on the arch *q r*, lay on the degree of inclination which the original plane has to the ground; and draw *p q* produced till it cut the vertical line *s d* in S; then will S be the vaniſhing point of the ſquare in the in-

Fig. 7.

Fig. 6.

Fig. 8.

T. Sheraton Del. Published as the Act directs by T. Sheraton May 9.th 1792. J. Barlow Sculp.

clining plane, for the ſame reaſon as *s* is of the ſquare 11, 12, 10, 8, on the level ground. Make S P equal to *s p*, and P will be the point of diſtance to the inclined plane. Draw the viſuals A S, F S, and from A draw A P, cutting the viſual F S in O. Laſtly, draw O N parallel to A F, and the repreſentation of the ſquare will be found as propoſed. See Caſe 9, page 221.

Obſervations.—The viſuals A S, F S, may be cut by another method to the ſame effect. Thus: draw the line 5 6 parallel to S *p*, and take the ſide of the original ſquare and place it from A to 5. Draw from 5 a line to *p*, the diſtance on H L, and it will cut at N, as before. The truth of this will appear by comparing No. 1 with No. 3. At No. 1 draw G R for a ground line, and perpendicular to it draw A *s*, a ſection of the picture. Lay on, from A to *s*, No. 1, the height of the common horizon; that is, from A to *s* on the perpendicular line A B *s*, Fig. 9. From *s*, the center of the picture at No. 1, draw *s p* equal *s p* the diſtance at Fig. 9. Make A N, the inclined plane, of equal angle to *q p r*, the angle which the original plane makes with the ground. From A to N, No. 1, lay on A F equal to ſide of the ſquare No. 3. Lay the ſame from A to G, No. 1. Laſtly, draw G *p*, N *p*, cutting the picture at *n* and 8. Take, in the compaſſes, the ſpace from A to *n* at No. 1, and lay it from 9 to N at No. 3, and it will be ſeen that they are equal. In the ſame manner take A 8 at No. 1, and lay it from 9 to 8 at No. 3, and

it will be found that they are equal. This fully demonſtrates the truth of the repreſentation of the ſquare A F, N O; for, beyond all diſpute, *n*, at No. 1, ſhows how much the ſquare on the inclined plane riſes on the picture; and 8, at No. 1, as certainly ſhows how much the ſame ſquare lying on the level ground riſes; and ſince they both coincide with their repreſentations at No. 3, there can remain no doubt but S is the true vaniſhing point, and P the true point of diſtance.

N. B. This problem is of uſe to repreſent any table top hinged at the front, and riſing by a horſe behind to any pitch.

Prob. VI. Fig. 9. Plate XVI.

To find the Repreſentation of a Square lying on the Ground, having its Sides oblique to the Picture.

Operation.—Draw the plan of the ſquare propoſed, as 1, 2, 3, 4, in any angle to the ground line G R, as may be required. Produce the ſide 1 4 till it cut the ground line at *k*. Alſo produce the ſide 1, 2 till it cut at 1 4. Let *s* be the center of the picture as uſual, and draw *s d* perpendicular to H L. Let *d* be the diſtance of the eye from the picture. From *d*, draw *d* V parallel

rallel to 1, 2, one of the ſides of the ſquare. From *d*, draw *d v* at right angles to *d* V, then will V *v* be the true vaniſhing points of the ſides of the ſquare; for the line *d* V is parallel to the ſide 1 2, and *d v* is parallel to 1, 4; wherefore *v* V are the true vaniſhing points. Hence, from 1 4, and from 3, draw right lines to V, and from *k* and 3 draw lines to *v*; and where theſe lines cut each other at *d*, *b*, *a*, *c*, will be the repreſentation of the original ſquare 1, 2, 3, 4, as required.

Method ſecond. — To draw the ſame ſquare without the trouble of a ground plane.

Operation.—Every thing remaining as before, extend the compaſſes from *v* to *d*, and lay *v d* to *m* on the horizon; then will *m* be the meaſuring point to the viſuals 3, *v*, *k*, *v*. Make *d* 13 on the ground line equal to the ſide of the ſquare. From 13 draw a line to *m*, cutting the viſual 3 *v* at *b*. From *b* draw *b* V, cutting at *a*, as by the firſt method.

The angle of the original ſquare being brought into the picture at 3, a line from 3 to V finds the other ſide *d c*, without any further trouble.

Obſervations.—The truth of this problem will appear from what has been ſaid in Caſe 7, p. 219, which I would adviſe the reader

reader to examine. And I would further remark, that if viſual rays be drawn from each angle of the original ſquare 1, 2, 3, 4, to the vertical line *s d*, they will cut at *b*, *a*, *c*, as in the preceding methods. The rays from Z X to P, in Plate XIV. Fig. 2, are the ſame to the original Z X, as the rays 1 *d*, 4 *d*, are to the ſide of the ſquare 1, 4, in the figure before us. For *c a*, in this figure, is the repreſentation of 1, 4—and *z*, *x*, on the picture in Fig 2, Plate XIV. is the repreſentation of Z X.

PROB. VII. FIG. 9. Plate XVI.

To find the Repreſentation of a Square ſuppoſed to be ſituated in a a Plane perpendicular to the Ground, but oblique to the Picture.

FOR this problem, the picture being completely prepared as for the preceding one, the operation will be extremely conciſe, as follows:

Operation.—Raiſe a perpendicular line A B, No. 2. On the perpendicular A B lay the ſide of the ſquare from A to B. From B and A draw viſual lines to *v*, the vaniſhing point; found as before. From A, lay down the ſide of the ſquare to *i*; and from *i* draw *i m*, cutting the viſual line A *v* in D. Laſtly, draw D C parallel

parallel to A B, and the repreſentation will be found as required. See remarks in Caſe 8, page 221.

Prob. VIII. Fig. 10. Plate XVI.

To find the Repreſentation of a Square having its Sides oblique to the Picture, ſuppoſed to be in a Plane inclined to the Ground, as in Problem V.

Observations.—This problem differs in no reſpect from the fifth, except what relates to the ſquares repreſented in theſe inclined planes. In the fifth problem, the ſquare in that inclined plane, having two of its ſides parallel to the picture, the others of courſe vaniſh in S, perpendicular to *s*, the center of the picture. In this problem the ſquare repreſented in the inclined plane has its ſides oblique to the picture, and therefore they vaniſh to two points in ſome new vaniſhing line, *h l*, parallel to the common one H L; becauſe the interſection of the inclined plane is parallel to the ground line.

Operation.—Draw, as uſual, G R the ground line, and H L the horizon. Let *s* be the center, and *d* the diſtance of the picture. Draw A B, one ſide of the original ſquare; make

make *d* V parallel to A B, the ſide of the ſquare; and draw *d*, V L, at right angles with *d* V, then will V, V L, be the vaniſhing points of the ſquare 4, *p*, 5, 6, on the level ground. Make V M equal V *d*, and L V *m* equal L V *d*; then will *m* and M be the meaſuring points of the viſuals tending to V, V L. Thus far the picture is prepared only to repreſent the ſquare on the level ground; therefore we muſt proceed to find the vaniſhing line, points, and meaſuring points, of the inclined plane, thus:—Draw perpendiculars at pleaſure from V, and V L. From M draw M *v*, in an angle to V M equal to the angle which the inclined plane makes with the ground. Through *v* draw *h l* parallel to H L, cutting the perpendiculars V *v* at *v*; then will *v v* be the vaniſhing points ſought. Make *v n* equal *v* M, and *n* will be the meaſuring point ſought. Draw then the viſuals 4 *v* and 4 *v l*. Make 4, *o*, 4, *r*, equal to the ſides of the original ſquare B A. From *o* draw *o n*, cutting at 1; and from *r* draw *r p*, cutting at 3. From 3 draw 3 *v*, and from 1 draw *i v l*, interſecting at 2; then will 1, 2, 3, 4, be the repreſentation of the ſquare propoſed.

Obſervations.—The line *t* B paſſes through the diagonal of the original ſquare, whoſe ſide is A B. Draw from *d*, the diſtance, a line parallel to B *t*, cutting at *g* on the common horizon. From 4 draw a line to *g*, and it will paſs through the diagonal of the

ſquare

Fig. 9.

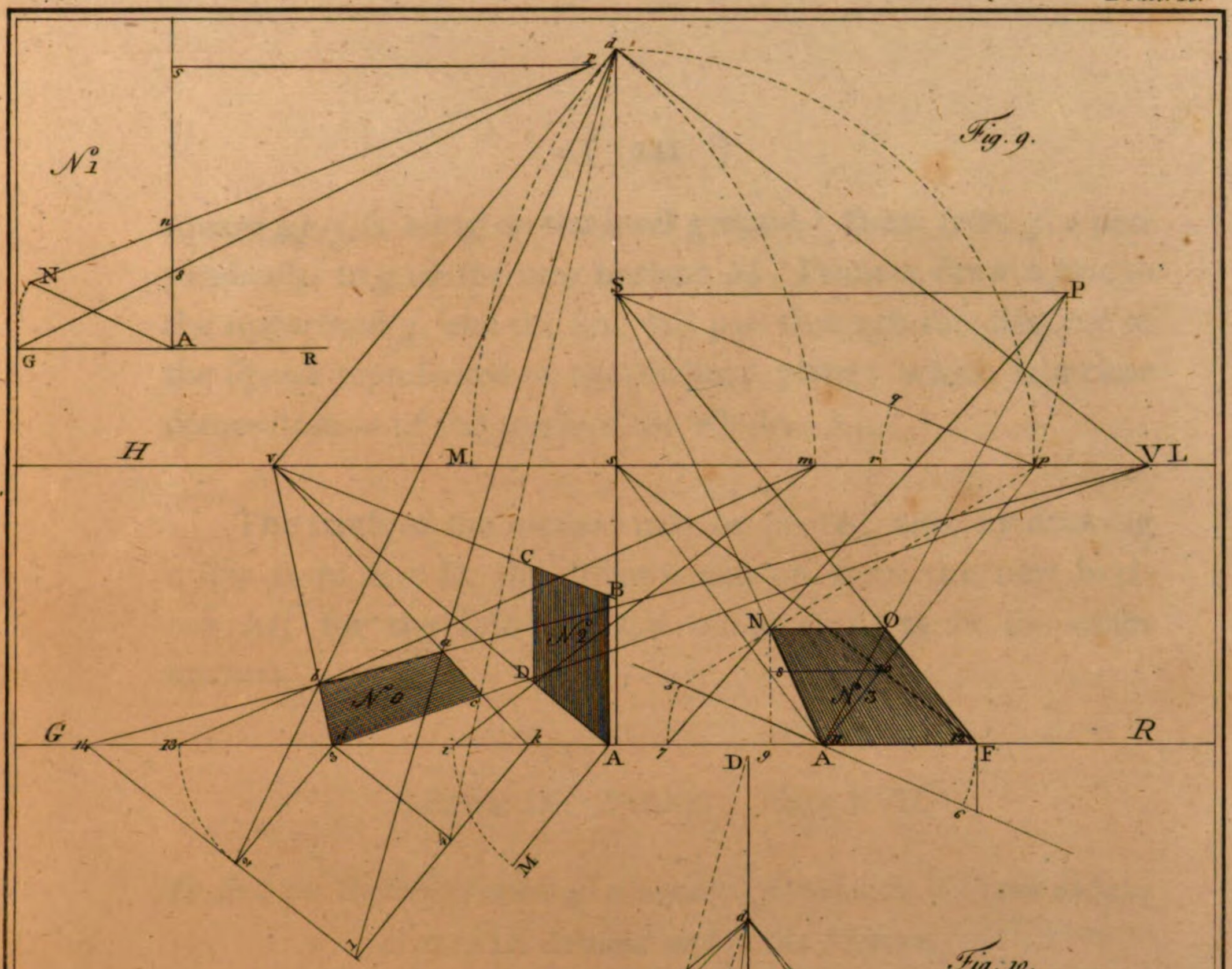
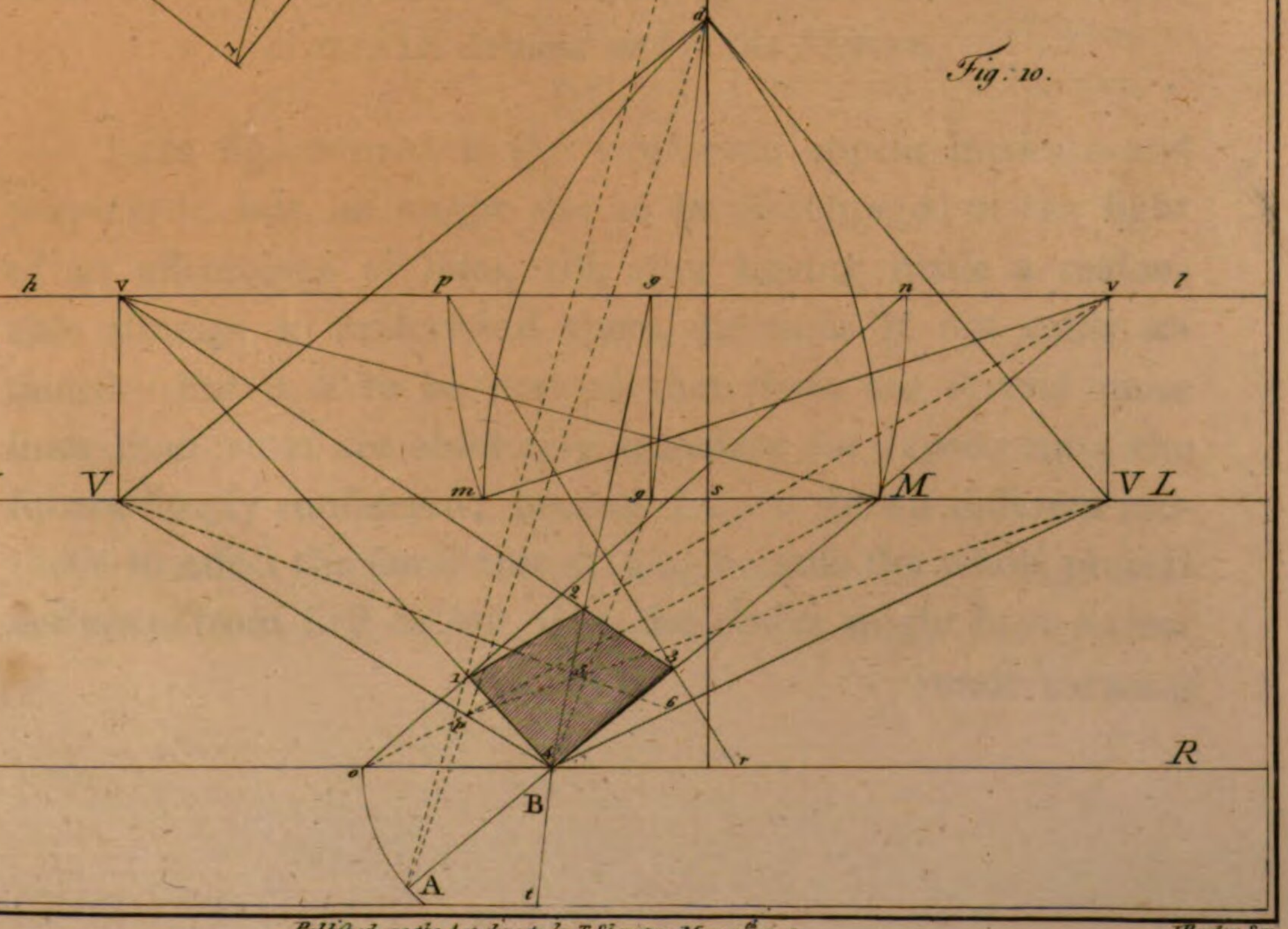
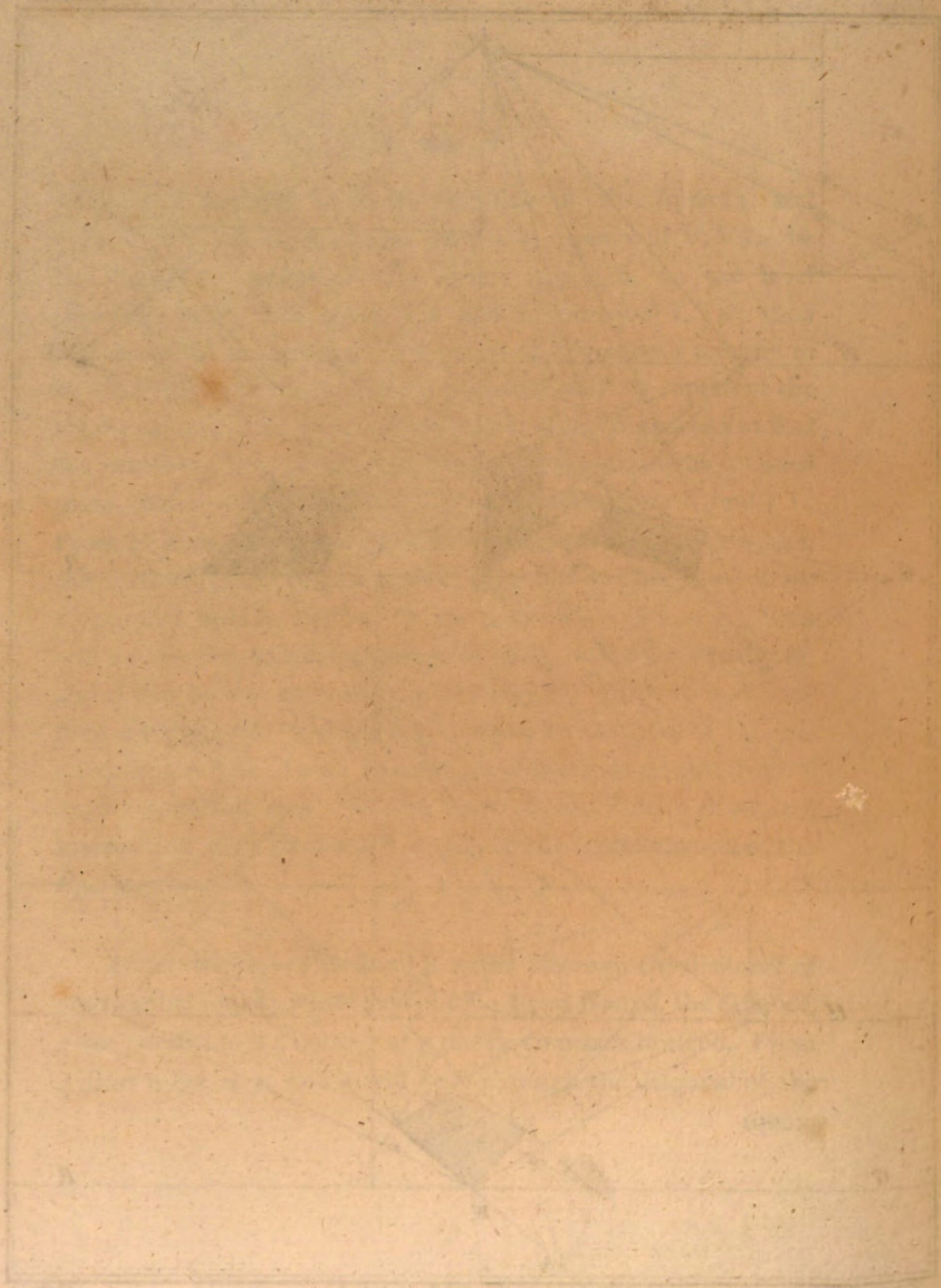


Fig. 10.



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ſquare 4 *p*, 5, 6, lying on the level ground. Draw from *g*, a perpendicular to *g* on the new horizon *h l*. From 4 draw a line to the uppermoſt *g*, and the line will paſs through the diagonal of the ſquare repreſented on the inclined plane; which is a clear demonſtration of the truth of the whole.

The truth of the method may be proved, alſo, by drawing a line from A to D, the diſtance laid on from the new horizon *h l*; for the line cuts the viſual at 1, as in the other method.

Prob. IX. Fig. 11. Plate XVII.

To find the Repreſentation of a Square, ſituated in a Plane oblique both to the Ground and to the Picture.

This figure may, to the workman, appear intricate and perplexed; but he ought not to be diſcouraged at the ſight of an aſſemblage of lines, till, after having made a reaſonable attempt to underſtand them, he finds it not eaſily attained. But it is to be noticed, that there are ſeveral more lines than what are abſolutely neceſſary for repreſenting the ſquare ſimply conſidered; becauſe I have ſhown different methods to effect the ſame thing; and becauſe the whole proceſs is ſhown from firſt to laſt, that the reader might have a clear

underſtanding of a problem really uſeful, but rarely known amongſt workmen, and even not amongſt painters.

Operation.—Draw G R, the ground line, and H L, the horizon, as uſual; and make *s* the center of the picture. Draw *s d* perpendicular to H L; and let *d* be the diſtance of the picture. Make the angle *d v s* equal to the angle which the ſquare in the inclined plane makes with the picture; and draw *d* P at right angles to *d v*; and make *v m* on H L equal *v d*. Draw at pleaſure *m* M *o* perpendicular to the horizon. Make *v* M to incline in an angle equal to that which the original plane makes with the ground. Draw M, V *x* parallel to the horizon; and from V *x*, draw V *x*, *v*, which will be the vaniſhing line of the inclined plane. From the center *s*, draw *s* S, *d x* perpendicular to the vaniſhing line *v*, V *x*. From *s*, draw a line to *d* 1, parallel to *v* S V *x*. Extend the compaſſes from S to *d* 1, and make S, *d x*, equal to S, *d* 1; then will S, *d x* be the diſtance of the picture for the inclined plane. Make V *x*, *m* 2, equal V *x*, *d x*, and *m* 2 will be the meaſuring point.

The picture being thus prepared for delineating the ſquare, draw from A, the viſual A *v*; and from A, the viſual A, V *x*. Draw A X parallel to the vaniſhing line *v*, S V, *x*. Lay on, from A to *w*, a ſpace equal to the ſide of the ſquare; and from *w*, draw *w*, *m* 2, cutting at D. From D, draw a line to *v*, for the ſide

of the ſquare D B. Make alſo A N equal to the ſide of the ſquare; and draw N *m*, cutting at G; and laſtly, draw G V *x*, cutting at B; and the ſquare will be completed as required.

Method ſecond.—From A, ſweep the arch *k* K, whoſe radius is equal to the ſide of the ſquare to be repreſented. Draw A *u* equal to the angle of the inclined plane with the ground; and from *u*, draw *u t* parallel to the ground line; from *t* draw a viſual to P; and from *u*, draw *u* M, cutting at D; from A draw a line through the interſection of *u* M with *t* P, and produce this line till it find the vaniſhing point V *x* in the perpendicular P V. From D draw a line to *v*, as before; and laſtly, from G, found as before, draw G V *x*, cutting at B, and the ſquare will be completed, as in the other method.

Obſervations.—If the original plane inclined to the ground in an angle of forty-five degrees, the viſual line of the ſide of the ſquare A D would paſs through the diagonal of the ſquare A, *k*, *n*, 8, and tend to the upper V, the vaniſhing point in that caſe; and V *v* would then be the vaniſhing line, S would be the center of the picture, *m* the meaſuring point, and *d* 3 its diſtance, and *v*, *d* 3, Q would be the angle of the inclined plane, which is the diagonal of a ſquare *v*, *d* 3, Q, *m*. It is evident then, that the true repreſentation of a ſquare in any inclination, would

deſcribe a quadrant of a circle, whoſe radius would be the ſide of the ſquare repreſented, as the figure ſhows.

N. B. No. 1 is the ſame problem, diveſted of all lines but ſuch as are abſolutely neceſſary to its repreſentation; which, it is preſumed, will be readily underſtood by inſpection, after what has been ſaid on Fig. 11. See page 224.

Prob. X. Fig. 12. Plate XVIII.

To repreſent a Floor of Squares parallel to the Picture.

G R is the ground line, and H L the horizon.

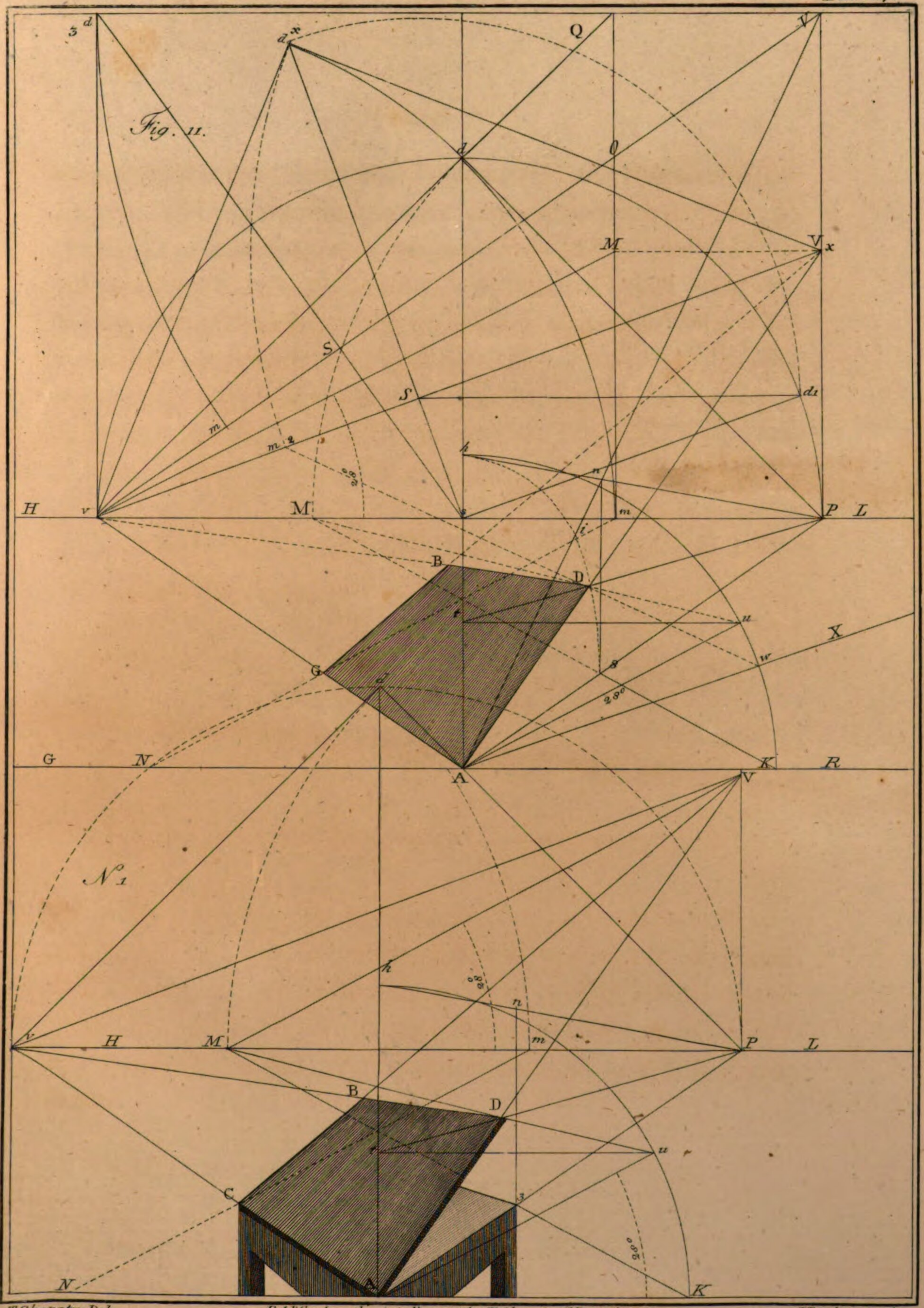
Let *s* be the center, and *d* the diſtance of the picture.

Let it now be required to repreſent thirty-ſix ſquares.

Operation.—Lay A D, the ſide of the original ſquare, ſix times on the ground line G R, contained between A *h*, as the figure ſhows. Draw from each diviſion on the ground line viſuals to *s*; and from *h*, draw a line to *d*, the diſtance; which line will cut each viſual in *i*, *k*, *l*, *p*, *q*, *r*. Through the

ſeveral

Fig. 11.



T. Sheraton Del. Published as the Act directs, by T. Sheraton May 12th 1792 J. Barlow Sculp.

ſeveral points of interſection marked by theſe letters, draw lines parallel to G R, the ground line, and there will be produced the number of ſquares required. But if it be neceſſary to fill up the picture with theſe ſquares, and there be no room for laying A D on the ground line beyond *b*, then continue the laſt parallel line *r o a b c* the whole extent of the picture; and take *o a* equal to the ſide of the ſquare, and repeat it *a*, *b*, *c*, as may be neceſſary. From *s*, draw *s b*, produced forward to the ground line. In the ſame manner draw *s c* forward, and ſo on repeatedly. Then, laſtly, draw parallel lines from the former ſquares, by which means the picture will be filled up to the ſides.

Obſervations.—The diagonal line *b d* paſſes through the oppoſite angles of the large ſquare A, *r*, *a*, *b*, which includes all the other; and a line through the oppoſite angles of any of the ſmall ſquares, will alſo tend to the ſame point of diſtance *d*.

Of the Repreſentation of Rectangular Solids in different Poſitions to the Picture.

Prob. XI. Fig. 12. Plate XVIII.

To repreſent a Row of Cubes, or a Priſm, parallel to the Picture.

Operation.—The ground line, horizon, &c. remaining the ſame as for the floor of ſquares, draw A, B, C, D, a geometrical ſquare, equal to one ſide of the cube. Draw the viſuals A *s*, B *s*, C *s*, D *s*. From D, draw D *d*, cutting at 1. Draw 1, 2, parallel to the ground line, cutting D *s* at 2. From 2 raiſe a perpendicular, cutting C *s* in 5; from 1 raiſe a perpendicular to 4, cutting B *s* in 4. Laſtly, from 4 draw a line to 5, parallel to the ground line, or to B C; and the repreſentation of the firſt cube will be completed. Next, from 2 draw 2 *d*, cutting at 3; draw 3, 8, cutting D *s* in 8; from 8 draw 8 *d*, and it will find the baſe of the ſecond cube; and repeating every thing as in the firſt cube, any number of them may be drawn till they vaniſh in the point *s*.

Obſervations.—If a number of cubes, or priſms, are to be repreſented in various places on the picture, it will be done with

with the moſt eaſe, firſt, to repreſent a floor of ſquares equal to the ſide of the cubes, or baſe of the priſms. Thus, for inſtance, the priſm *r* is eaſily delineated on the back part of the picture, by raiſing a perpendicular M N equal to the original height of the priſm. Draw N *s*, and from any ſquare where it is to ſtand, raiſe perpendiculars cutting N *s* at *r*. From *r* draw a line parallel to the ground line, which will complete the priſm. In like manner the cube *k i* may be repreſented any where.

Laſtly, we may ſee, in the repreſentation of a cube, that it conſiſts of three different caſes of geometrical ſquares; that is, A, D, 1, 2, is the repreſentation of a ſquare lying on the ground; and 1, 4, 5, 2, is the repreſentation of a ſquare perpendicular to the ground, and parallel to the picture: and D, C, 5, 2, is a ſquare repreſented both perpendicular to the ground and to the picture. The other three ſides of the cube are reſpectively parallel to thoſe we have mentioned, and therefore are the ſame in all reſpects.

PROB. XII. FIG. 13. Plate XVIII.

To repreſent two Rows of Cubes oblique to the Picture.

OPERATION.—G R is the ground line, and H L the horizon. Let *s* be the center of the picture, and *s d* the diſtance. From *d*, draw *d* V, cutting H L in V, and parallel to that ſide of the original cube; whoſe repreſentation is A B C *g*. Draw *d v* at right angles with *d* V, cutting at *v*; then will *v* be the vaniſhing point of the right hand ſide of the ſquare. Make V M equal V *d*, and *v m* equal *v d*; then will M *m* be the meaſuring points. From A, the angle of the firſt cube, draw the viſual A *v*. Draw alſo A V. Make A B equal to the ſide of the cube, and from B draw B V, B *v*. Next, lay A B to 7, and from 7 draw a line to the meaſuring point *m*, cutting at *a*. Lay A B to *c*; and from *c* draw *c* M, cutting at *g*; from *g* and *a* raiſe perpendiculars to C and D; from D draw a line to V, and from C to *v*, which will complete the repreſentation of the firſt cube.

The ſpace between the cubes being conſidered equal to the ſide of the ſquare, repeat A 7 each way on the ground line, as often as there is room, as at 8, 9—*d*, *e*, *f*. From each of theſe

diviſions

diviſions draw lines to their reſpective meaſuring points *m* M, cutting A *v* in *b* and in 2, and AV in *b i k*. Raiſe perpendiculars from *b* and 2, cutting the upper viſuals. Do the ſame from the other points *b i k*, and proceed in all reſpects as with the firſt cube, and there will be two more produced.

Obſervations.—If it were required to repreſent two additional cubes to each row, it is evident that we muſt have recourſe to ſome expedient for this purpoſe; becauſe there is not room beyond 9 and *f* to lay on any more diviſions. Therefore from 2 produce a line parallel to the ground line, and from *k* do the ſame. And obſerve, that a line from 8 to *m*, and from *e* to M, cut theſe parallel lines at *n* and 1. Extend the compaſſes from 1 to 2, and repeat this at 3, 4, 5, 6, and from theſe diviſions draw lines to *m*, and they will cut the viſual A *v* in the ſame points in which it would have been cut if theſe lines had been drawn from the original diviſions on the ground line. Laſtly, a line from *e* to M will cut the left hand parallel at *n*; repeat *n k* at *p q r*, and proceed as before. By this method, which is quite ſimple, it is evident we may draw as many cubes as we pleaſe, by adding parallel lines to the ground line.

Of drawing Viſual Lines tending to Vaniſhing Points out of the Picture.

In the practice of drawing it is frequently found, by experience, that if we make uſe of a ſhort diſtance, the figure we repreſent will appear diſtorted and unnatural; and when we, to avoid this, make uſe of a long diſtance, it will perhaps exceed the paper or picture we draw on: alſo, in the repreſentation of objects obliquely ſituated to the picture, their vaniſhing points not being in the center, it often follows, as the conſequence of chooſing a long diſtance, that the vaniſhing points far exceed the limits of the picture. To alleviate theſe difficulties, we propoſe the following problem.

Prob. XIII. Fig. 14. Plate XVIII.

To repreſent two upright Priſms obliquely ſituated, whoſe Diſtance and Vaniſhing Points exceed the Limits of the Picture.

Let the double line on each ſide of Fig. 14 be conſidered as the boundaries of the picture. Draw, as uſual, the ground line G R, and the vaniſhing line H L, and make *s* the center of

the picture. Let *s d* be conſidered as only half the diſtance, becauſe there is no more ſpace on the picture above *d*. From the point *d*, draw a right line each way, at a diſtance from *s*, equal *s d*, forming a right angle; becauſe the ſides of the priſms are originally perpendicular to each other. Make *v m* equal *v d*; then would *m* be the true meaſuring point, provided *s d* were the whole diſtance of the picture; and in this caſe *v v* would be the vaniſhing points of the ſides of the priſms; but ſince *s d* is only half the real diſtance, take in the compaſſes *s m*, and repeat that ſpace to M, and make *s* M, *s* M, equal, then will MM be the true meaſuring points to the whole diſtance. Produce the vertical line *d s* to A, cutting the ground line at A. Divide *s d* into any number of equal parts, as 1, 2, 3, 4, and, for the ſake of accuracy, ſubdivide theſe as in the figure. Lay on the ſame diviſions downwards from *s* to A.

The next thing to be conſidered, is to draw a line perpendicular to the horizon, of ſuch a proportion to *s d*, at any given diſtance from *s*, the center, according to the boundaries of the picture, that when a line is drawn from *d*, touching the top of the ſaid perpendicular, it would exactly tend to the true vaniſhing point, were it produced to the horizontal line. We ſhall ſuppoſe then, that a perpendicular line is drawn from the point *v*, which is exactly half the diſtance from *s* the center, to V the vaniſhing

point out of the picture. Make then the ſaid perpendicular line $v4$, half the length of $s\,d$; then a line paſſing from d to 4 would, if produced, terminate at V, the true vaniſhing point. Divide $v,4$ in the ſame manner as $s\,d$, and downwards from v to 3 lay on the ſame diviſions; for $v\,3$ is half the length of s A. Laſtly, make the other ſcale on the left in the ſame proportion, then will the picture be properly prepared for delineating the propoſed priſms.

Operation.—From A draw a line to 3, which will be the viſual for the bottoms of the priſms, for A 3 produced would tend to V. Make A c equal to the diſtance which the priſm is ſuppoſed to be from the picture; then, from c, draw a line to M, cutting at p; from p lay a ruler acroſs the two ſcale lines, and move the ruler backward and forward till its edge coincide with p, and any correſpondent diviſion on each ſcale. The ruler being thus fixed, draw a line $p\,b$, cutting the ſcale line s A in the ſecond diviſion, and the ſcale line $v\,3$ to the left in the ſame diviſion; then would $p\,b$ produced terminate in a point on the horizon equally diſtant from s as V is. Make A a equal to the left ſide of the priſm, and draw a M, cutting at b. Make $c\,e$ equal A a; and from c draw a line to M, cutting at h. From the points p, b, h, raiſe perpendiculars at pleaſure.

Conſider

Conſider now the height of the priſm, which we ſuppoſe to be A B; from B place the edge of the ruler, and move it till it be at ſimilar diviſions on each ſcale line, as before. The ruler being in this poſition, draw a line cutting the perpendicular *p* D at D; and from D, place the ruler till it coincide with ſimilar diviſions on each ſcale line on the left, which will complete the repreſentation of the firſt priſm; and for the ſecond, proceed in the ſame way, obſerving that, as there is not room on the ground line G R for repeating the ſide of the priſm *c e*, the ſcale line, or new ground line *h i k*, muſt be found, as in the preceding problem, by drawing through *h* a line parallel to the old ground line, cutting at *g*, then muſt the ſpace *h g* be laid to *i* and *k*, from which lines being directed to M, they will cut at *l o*.

Obſervations.—In Problem XXI. page 71, Plate II. Fig. 15, the geometrical principle is explained, upon which this method of drawing viſuals to points out of the picture is founded.

We there ſay, in page 72, "In whatever proportion the extreme line E P is divided, into the ſame proportion will the hypothenuſe line E O be divided." Agreeably to which, we may obſerve in the perſpective problem before us, that, in whatever proportion the diſtance *s d* is divided, a line being drawn from the ſaid diviſion parallel to the horizon, will cut

the

the viſual *d* V in that ſame proportion. The line *s d* being divided into two equal parts, a line from 2, parallel to the horizon, will cut at 4, which divides the viſual *d* V into two equal parts; and a line from the point 4, perpendicular to the horizon, will divide *s* V in the ſame manner. Hence it is evident, that if *s d*, *v* 4, be divided into the ſame number of equal parts, a line drawn through any two correſpondent diviſions, will tend to V, the vaniſhing point. It is alſo evident, by the ſame mode of reaſoning, that if the half diſtance *s d* were produced to twice its preſent length, which would then be the whole diſtance, a line from *d* to V would be equal to the ſpace from V to M, on the left the true meaſuring point, in the ſame manner as *d v* meaſures *v m*, which is only half that ſpace.

Of reducing the Point of Diſtance, ſo as to bring it within the Limits of the Picture.

IN making deſigns on a large ſcale, it is very common for the point of diſtance to exceed the bounds of the paper or board we draw on: to avoid the inconvenience of which, let the following problem be attended to.

PROB.

PROB. XIV. FIG. 15. Plate XVIII.

To find the Repreſentation of a Number of Squares when the Diſtance is out of the Limits of the Picture.

THE double lines which include the ſquares, are the boundaries of the paper, board, or picture we draw on.

Operation.—Let *s* be the center, and let *s d* be ſuppoſed half the length of the point of diſtance. Make then a ſcale on the ground line, whoſe equal parts ſhall be equal to half the ſide of the ſquares to be repreſented, as 3, 4, 5. Lay on from 3 to 4 half the ſide of the ſquare A, and from 4 draw a line to *d*, half the diſtance, which will cut the viſual 3 *s* in the ſame point as it would have been cut if *d* had been twice its preſent diſtance from *s*, and the whole ſide of the ſquare had been laid on the ground line, as at 5; for it is evident, that a line from 5 through *t* would terminate in a point on the horizon twice the diſtance of *s d*. From 4 lay on 5, 6, equal 3, 4, and drawing lines to *d*, we ſhall have the ſquares B C. Here the learner muſt obſerve another difficulty ariſing; for the ground line of the picture is filled up at 6, and we are ſuppoſed to want the repreſentation of three more ſquares; and as the point 6 is near the extremities

of

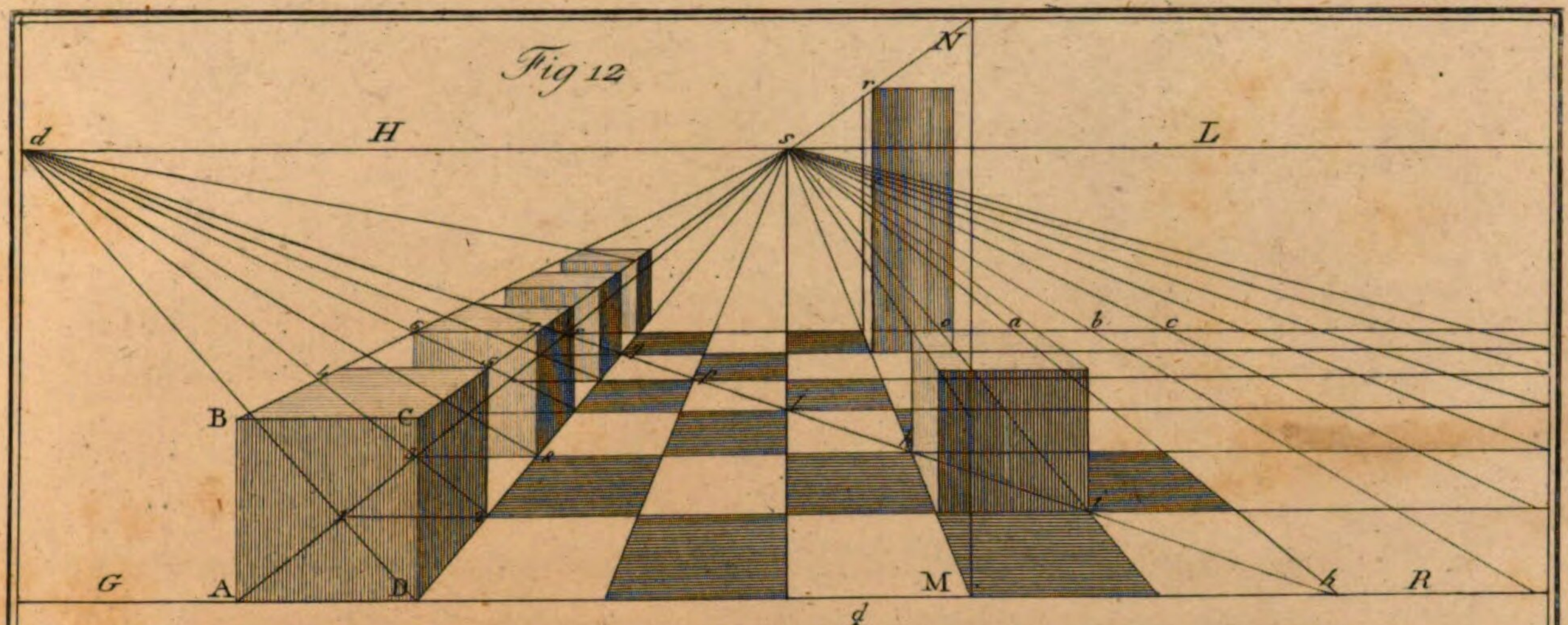
of the picture or board we draw on, there can be no opportunity to lay on the ſides of the ſquare any further; we muſt again therefore reduce the length of the point of diſtance to *h*, which is only one fourth of the whole diſtance; in proportion to which we muſt alſo reduce the ſcale on the ground line to one fourth of the ſide of the ſquare, as 1, 2; or, which is the ſame thing, divide the ſpace 5, 6, into two equal parts, and from 6, *o*, 5 draw lines to *h*, and three more ſquares will be cut off on the viſual line 3, *s*, as is evident from the figure.

Obſervations.—The truth of the repreſentation of the three laſt ſquares will appear, if the whole ſpace between 3 and 6 be placed from 6 to 9. Draw then from 9 a line to *d*, which will cut the viſual in the ſame points as before, when a line was drawn from 6 to *h*.

The advantage of this problem is very much experienced in the repreſentation of long ranges of buildings, ſuch as the internal views of ſtreets; in which caſe it is impoſſible to find room on the ground line for the full meaſurement of each front, not even when we have a very large board to draw on. I remember to have been very much embarraſſed myſelf in drawing the view of a long ſtreet, till I was informed of the above methods.

SECTION

Fig 12



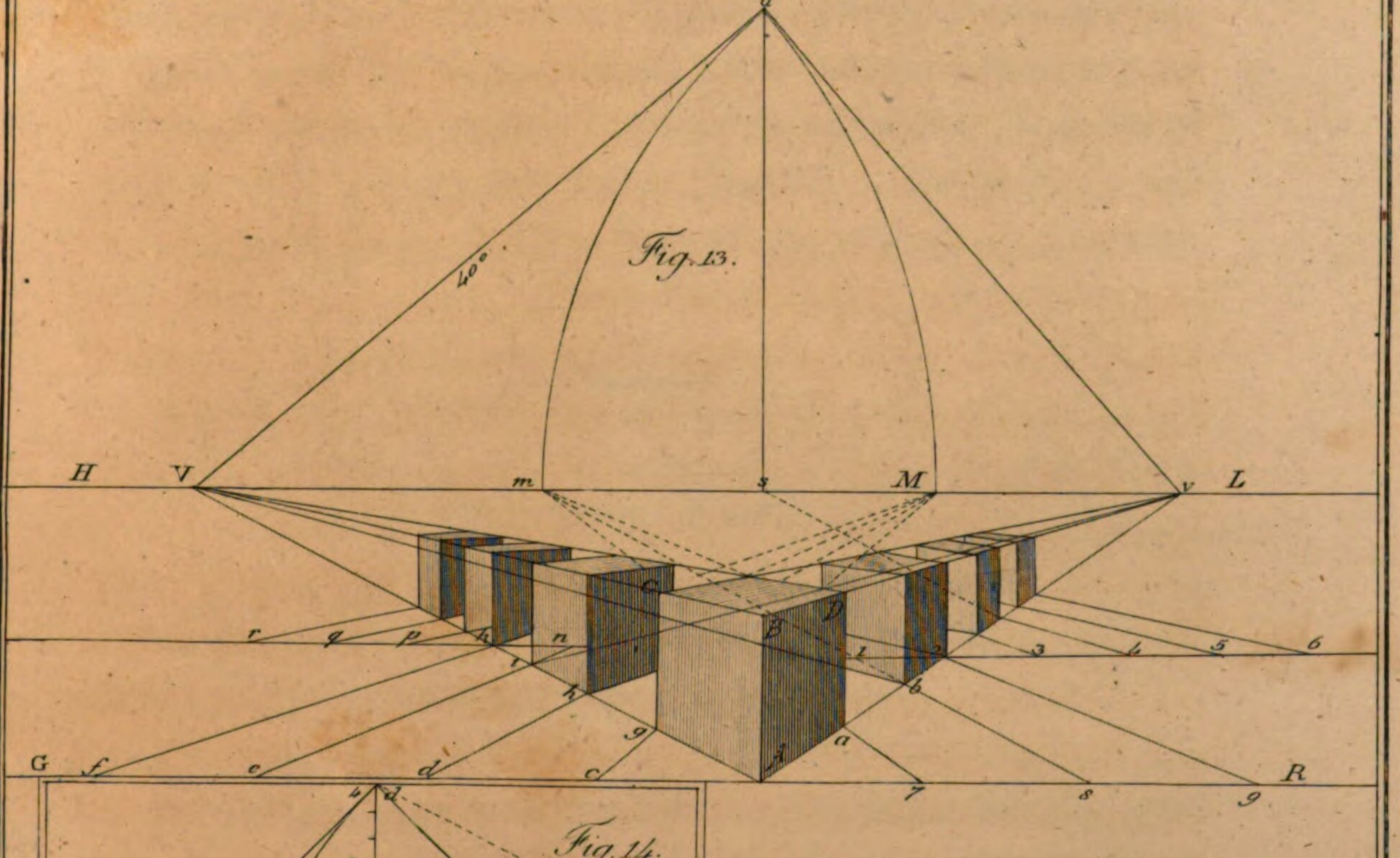
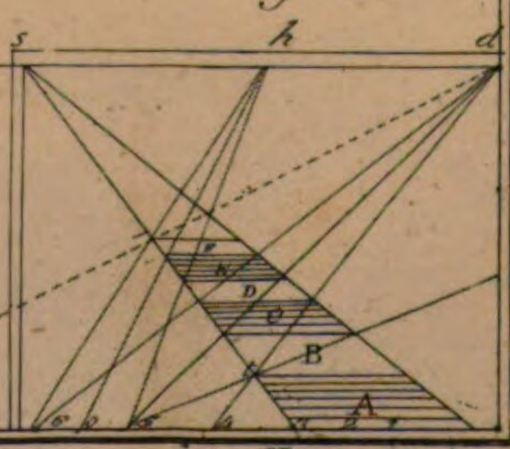


Fig. 13.

Fig. 14.

Fig. 15.



T. Sheraton Del. Published as the Act directs by T. Sheraton May 24th 1792. J. Barlow Sculp.

SECTION IV.

Of the repreſentations of Polygonal and Curvilinear Figures—containing ſome further Remarks on the Difference between the Repreſentation of Objects on a Plane, and their real Appearance to the Eye.—Of long and ſhort Diſtances, and the Repreſentation of a Row of Columns and Pilaſters, parallel to the Picture; together with ſome Obſervations on the Theory of Circular Objects.

Of Polygonal Figures.

LINES in three different poſitions to the picture, will repreſent any polygon in any ſituation whatever *.

A pentagon may have one ſide parallel to the picture; and if ſo, the other four will be oblique to it; or it may be placed ſo as to have all its ſides oblique.

* See the definition in page 49, and the various kinds of polygons in Plate II.

A hexagon may be ſo placed as to have two ſides parallel, and the other four oblique, as Fig. 16, Plate XIX. or it may have all its ſides oblique.

An octagon may have two ſides parallel to the picture, conſequently there will alſo be two perpendicular to it, and the remaining four will be each of them oblique, as Fig. 18, Plate XIX. The octagon in this ſituation, therefore, introduces all the variety of poſitions of lines that can exiſt in a picture, when the figure is ſuppoſed to be on the ground plane, or perpendicular to the picture; and ſince the theory of lines parallel, perpendicular, and oblique to the ground line, &c. has already been conſidered and applied to practice in the preceding ſection, in the repreſentation of geometrical ſquares and of cubes, nothing is requiſite here, but to apply the ſame principles to the repreſentation of polygonal figures.

The moſt uſeful of theſe are the hexagon and octagon; which, for brevity's ſake, I ſhall confine myſelf to, taking it for granted that, after the learner is acquainted with theſe, he will be able to delineate any other, from a pentagon to a duodecagon, as it may be found requiſite.

PROB. XV. FIG. 16. Plate XIX.

To repreſent a Hexagon having Two of its Sides parallel to the Picture.

OPERATION.—Draw the ground line and horizon, and make *s* the center of the picture, and *d* the diſtance. Through *d*, draw a line at pleaſure parallel to the horizon. From *d* deſcribe a ſemicircle, in which may be inſcribed half a hexagon, as 1, 2, 3. From *d*, through each angle of the hexagon, produce a line till it cut the horizontal line in V *v*; then will V *v* be the vaniſhing points of the four ſides of the hexagon, which are oblique to the picture. Draw the viſuals F *v*, B *v*, and B V, F V, and make B D and F A each equal F B, the ſide of the given hexagon. Draw A V, cutting the viſuals at 1 K; and draw D *v*, cutting at O N. Laſtly, draw K N parallel to F B, and the repreſentation will be completed as required.

Obſervations.—It is evident that a hexagon is compoſed of ſix equilateral triangles. The repreſentation contains ſix triangles alſo; and if a right line be drawn through each oppoſite angle, as from F N, &c. they will all interſect in the center *e*, in the ſame manner as the lines from each oppoſite angle on the

plan of the hexagon Y interſect each other in the true center, from which a circle may be deſcribed that will touch each angle.

Prob. XVI. Fig. 17. Plate XIX.

To find the Repreſentation of a hexangular Priſm, or Box, having two Sides parallel to the Picture, as before.

This problem may be ſolved by another method, which will help to confirm the truth of the laſt method.

Operation.—Draw the plan Y, and produce its ſides up to the ground line at *g*, *f*, *b*, *c*. Find the vaniſhing points *v* V as in the preceding problem. Draw the viſuals *g* V, *f* V, and *b v*, *c v*, which will interſect each other at *a*, *e*, *t*. Through *e* the center, correſponding with *e* on the plan, draw *h u* parallel to *q*, *r*, on the plan. From *v*, draw *v h*, produced to *o*; and from V, draw V *u*, produced to *n*. Laſtly, from *n* draw *n o*, which will complete the bottom of the box. Or it may be done by drawing the viſuals 8 V, 7 V, when the other viſuals are drawn, as the figure itſelf ſufficiently indicates. From each angle of the bottom perpendiculars muſt be raiſed, and produced at pleaſure. Next, draw *g p* perpendicular to the ground line, and

make

make *g p* equal to the height of the box; and draw *p* V, and produce *n*, *o* to *i*; and from *i* draw *i k*, and from *k* draw a line parallel to the ground line, which will cut the aforeſaid perpendiculars drawn from *o*, *n*, at 1, 6. The perpendiculars from *h*, *a*, were cut by *p* V at 2, 3. Draw 6 V, and 1 V, cutting the perpendiculars from *u* and *t* at 5, 4; from 5 draw 5 *v*, and from 4 draw 4, 3, and the outlines of the box will then be completed.

To ſhew the inſide, and the thickneſs of the edges of the box, proceed thus:—produce from the plan, *x w*, and from *w* draw a line to V, cutting *i o*; from its interſection in *i o*, raiſe a perpendicular to *k* 1; and from its ſection on *k* 1, draw a line to V; and where this line cuts the diagonal 2, 5, a line muſt be drawn from *v*, the vaniſhing point, to 9, the point of interſection, and produced till it cut the diagonal 1, 4, at 1; and from where it cuts this diagonal, draw a parallel to 1, 6; and from where it cuts at 6, draw a line to V; and from where this line cuts at 5, draw a line to *v*, cutting 4; and from where it cuts at 4, draw a line to the other interſection at 3, and the edges of each angle will be finiſhed.

Obſervations.—The hexagon in this figure is nearly the ſame in its plan as the other in Fig. 16; but as it is removed back from the picture, its appearance is more eaſy and natural

than that. The hexagon in Fig. 16 has one ſide, F B, in the picture, therefore F B is the full length of the ſide of the original hexagon, and the contractions of the other ſides appear more ſudden, and therefore more unnatural; but its repreſentation is equally true. The hexagon may, however, be repreſented by this method as far back as we pleaſe, by repeatedly laying F B, the ſide of the hexagon, on the ground line, as from D to E, and drawing E *v*, by which means we have another hexagon 1, 2, 3, 4, K, Z, whoſe appearance is perfectly natural.

Prob. XVII. Fig. 18. Plate XIX.

To find the Repreſentation of an Octagon, having two Sides parallel to the Picture.

Operation.—Draw G R, the ground line, and H L as in common; and make *s d* the diſtance of the picture, and *s* the center. Draw half the plan of the octagon at A, as follows.—Make *b g* equal to half the breadth of the plan; and from *c* ſweep the arch *b*, *i*, *e*. Biſect the arch in *i*. From *i* draw *i c*, cutting at *p*, and *p g* will be half the ſide of the octagon. Lay on *b p* to *b* 1, and a line from *p* to 1 is one ſide of the octagon.

Produce

Produce each ſide of the octagon up to the ground line; and from the points *f*, 8, 1, *b*, draw viſuals to *s*. From 8 draw a line to *d*, cutting at 7; from 1 draw a line to *d* alſo, cutting at 6. From 7 and 6 draw lines parallel to the ground line, cutting at 2, 3. Draw *f d*, paſſing through the diagonal of the ſquare in which the octagon is inſcribed. Draw 4, 5, parallel to the ground line. Laſtly, draw the ſides 1, 2,—3, 4—4, 5—5, 6, and 7, 8; which completes the repreſentation.

PROB. XVIII. FIG. 19. Plate XIX.

To find the Repreſentation of an octangular Priſm, or Box, having all its Sides oblique to the Picture.

OPERATION.—Draw the ground line and horizon, and let figure A be half the plan of the octagon. Let *s* be the center, and *d* the diſtance of the picture. Produce *n e*, *n p*, to the ground line; and draw *g* perpendicular to *e*. From *b*, *g*, 1, R, draw viſuals to *s*; and from R draw R *d*; by which a ſquare will be repreſented in which the octagon may be inſcribed.

Draw the other diagonal of the ſquare, which will cut the viſual *g s* in 8; the other diagonal R *d*, cuts the viſual *g s* in 6.

From

From 6 draw a parallel to 4, cutting the diagonal at 4; and from 8 draw a parallel to 2, cutting the diagonal at 2; through the center of the ſquare draw a parallel, cutting at 7 and 3. Laſtly, draw right lines to each point, and the bottom of the box will be completed.

Draw A F parallel to G R, and at a diſtance from G R equal to the height of the box. Then repreſent another ſquare A, F, G, D, and draw the diagonal each way. Then from 8 raiſe a perpendicular to 10, cutting the diagonal A D at 10. In the ſame manner, and to the ſame effect, raiſe a perpendicular from 6 to 11, from 5 to 13, from 4 to 14, from 3 to 15, from 2 to 16, from 1 to *o*, and laſtly, from 7 to 12. Draw then, as before, right lines to each point, and the whole repreſentation of the box will be finiſhed, except ſhewing the inſide and the edges of the box: having deſcribed how this is to be done in Problem XVI, I need not here repeat it; only it will be neceſſary to obſerve, that as the ſides of the octagon are drawn by this method without vaniſhing points, theſe points muſt be found by producing the ſides of the octagon till they cut the horizontal line H L, in the ſame way as the ſide 15, 14, is produced to *v*, which will be the vaniſhing point required for drawing the inſide line to, as the figure ſhews.

Fig. 16.

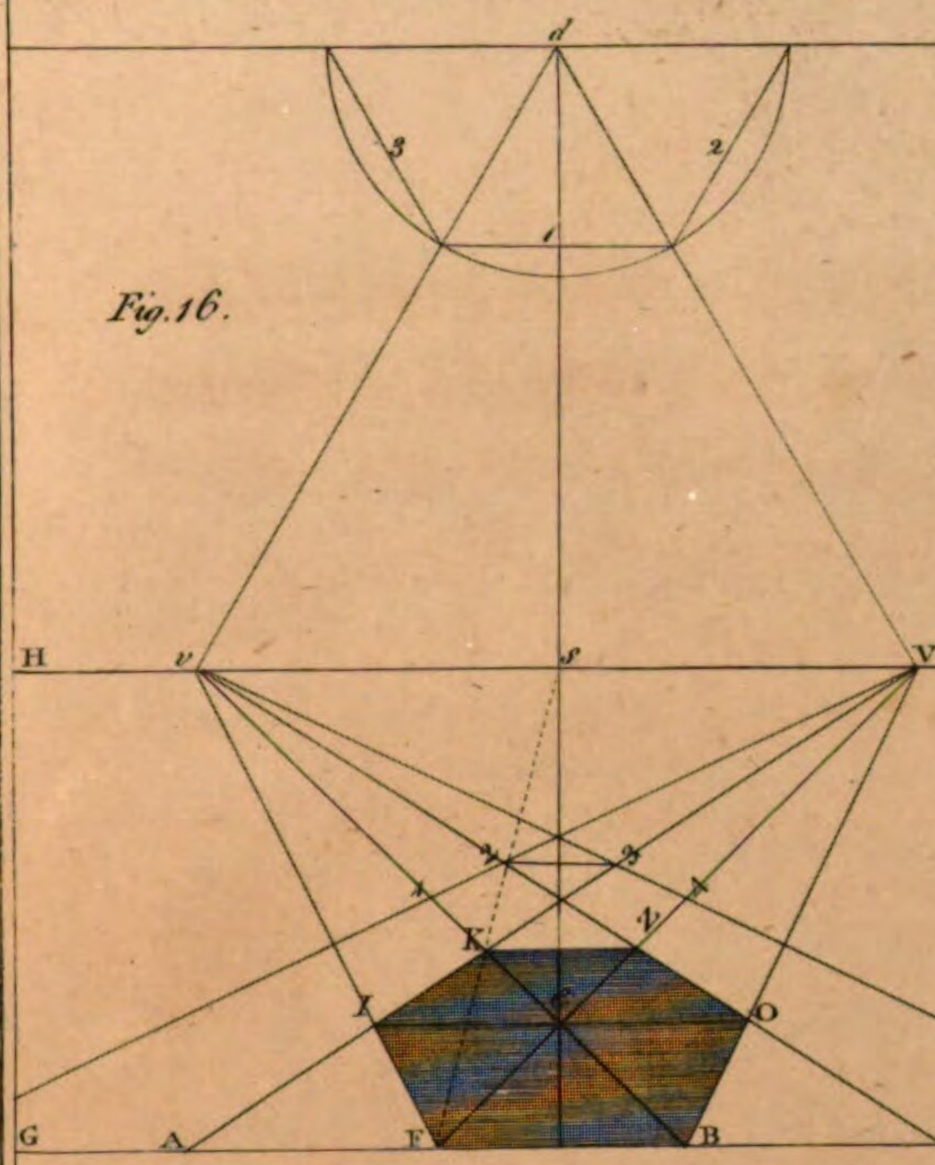


Fig. 17.

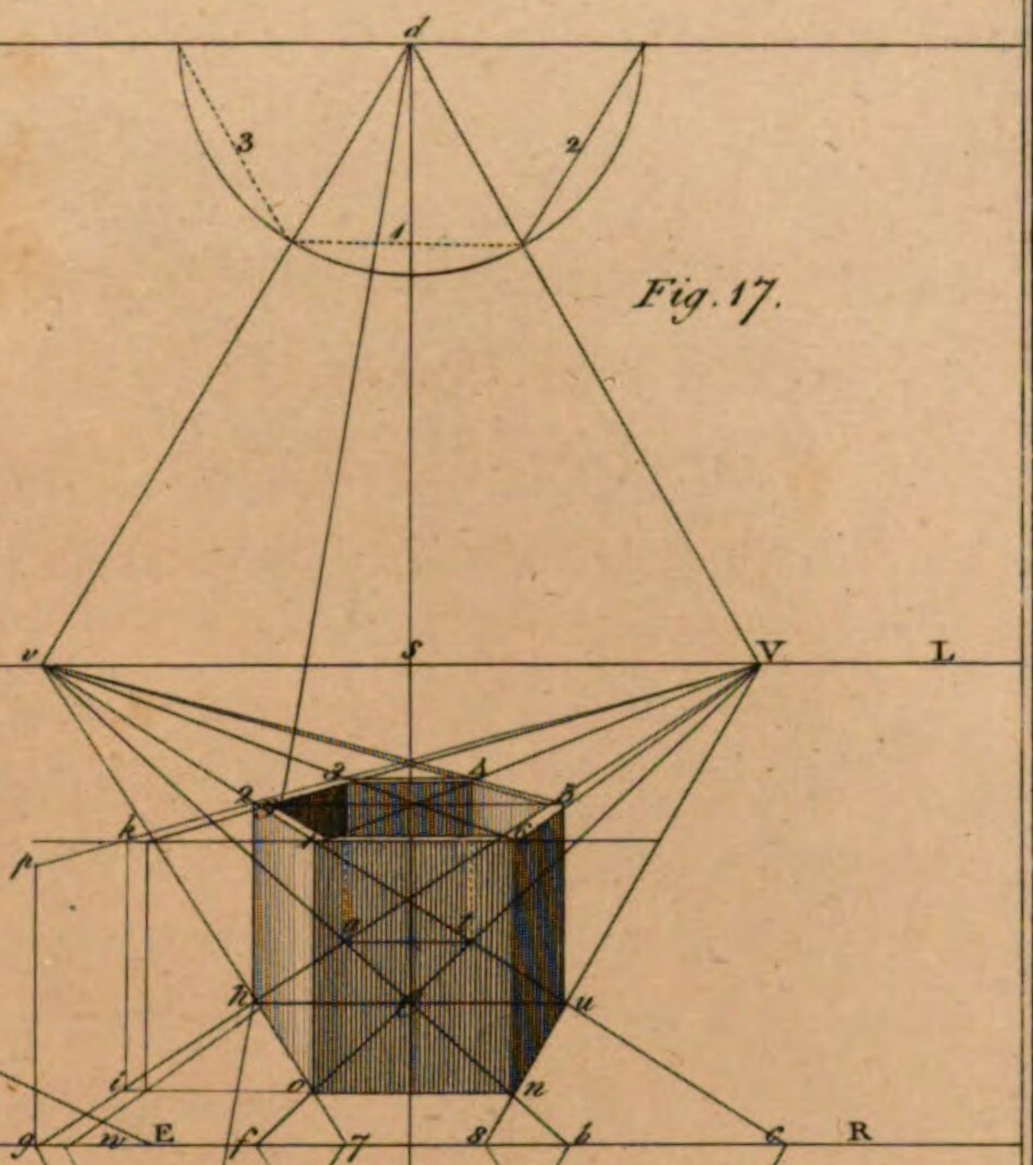
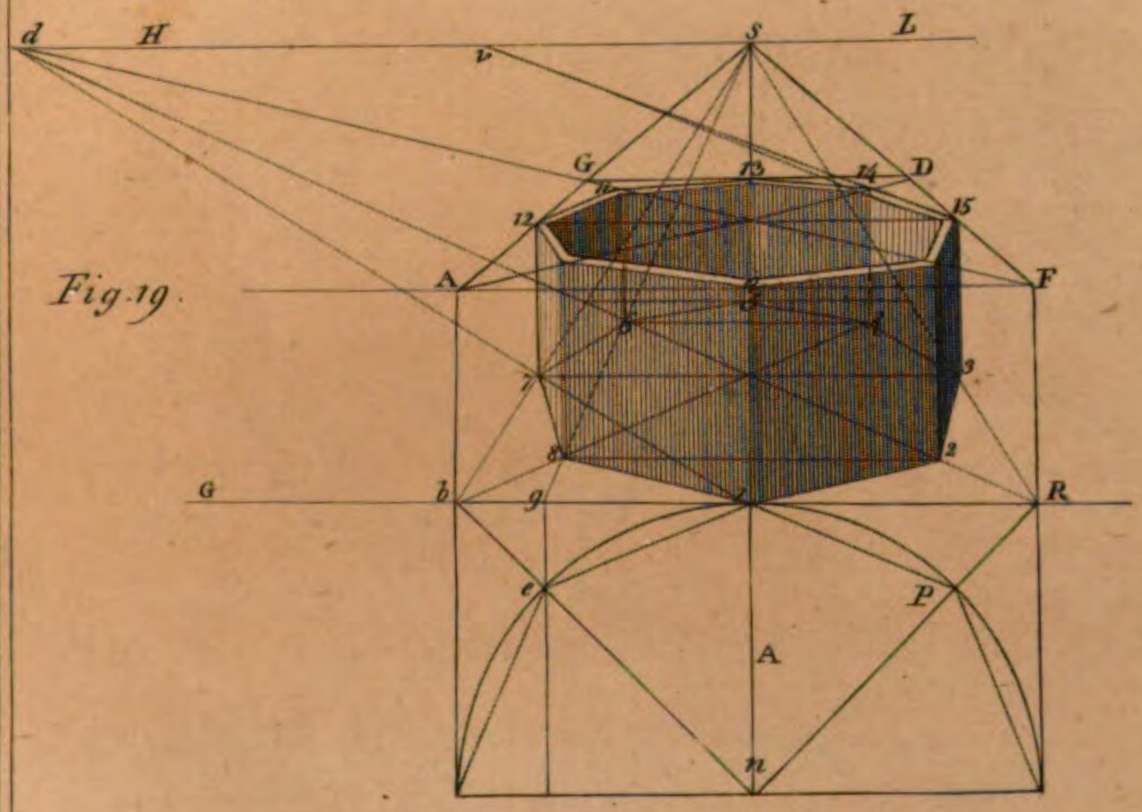


Fig. 19.



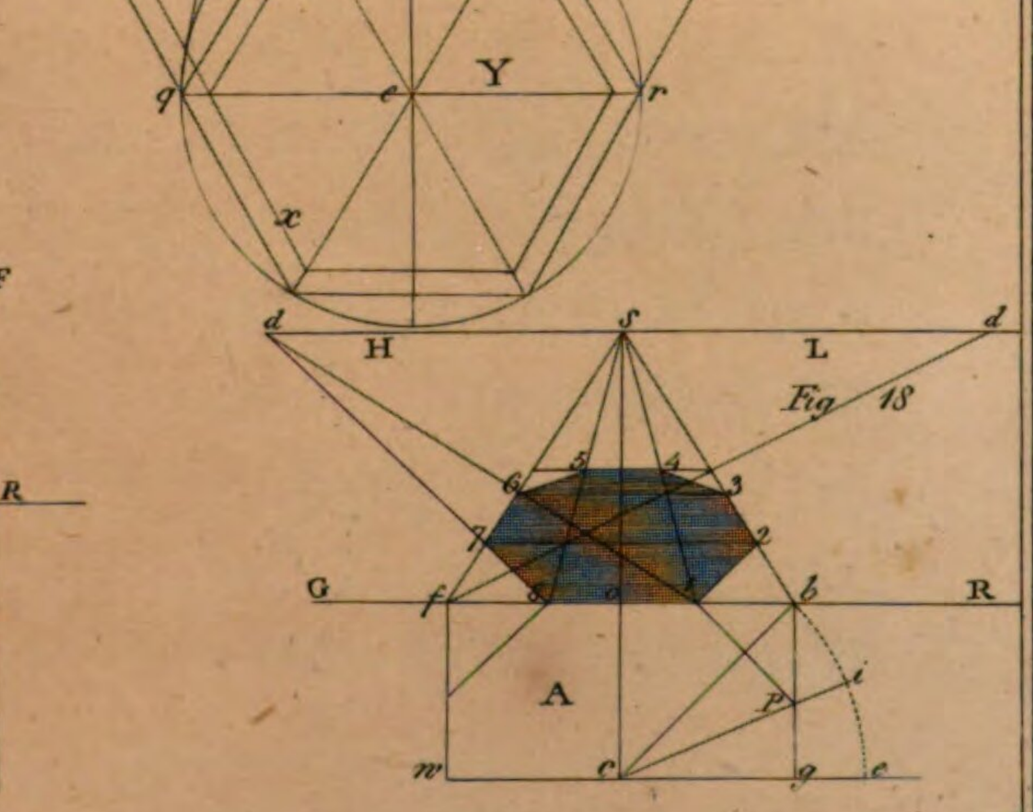
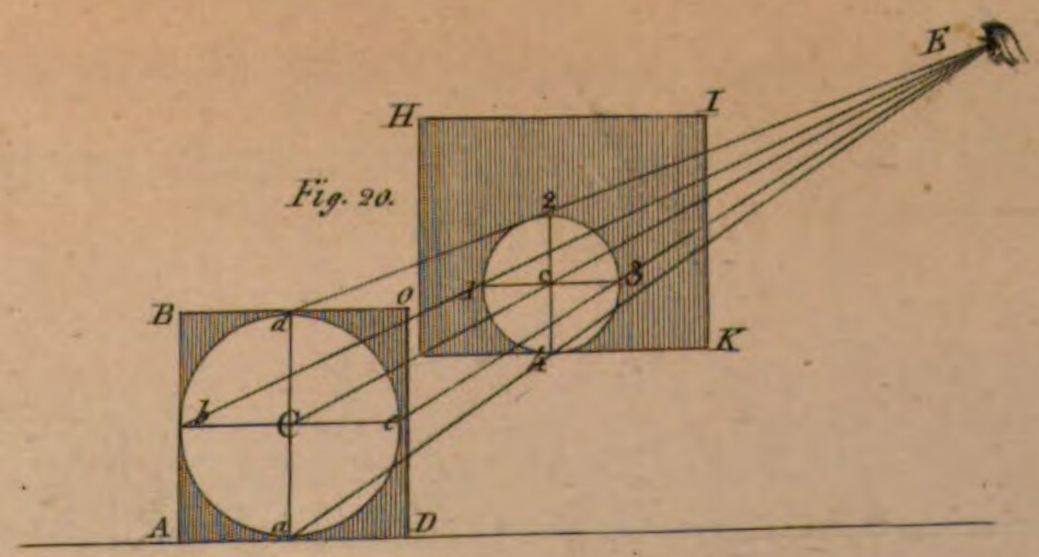


Fig. 20.



T. Sheraton del

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Some further Remarks on the Difference between the Repreſentation of Objects on a Plane, and their Appearance to the Eye.

We have already, in page 210, obſerved, that a perfect picture of objects, as they appear to the eye, cannot be delineated on a plane; we may conceive it to be done on the ſurface of a ſphere, if the ſpectator's eye be in its center. But this is only a ſuppoſition; for, in reality, there can be no ſtrict rules given for drawing perſpective lines on a ſpherical ſurface. A painter, in delineating objects on the inſide of a large dome, may make uſe of ſtraight lines, and the rules of perſpective, as applied to a plane; but he does this, becauſe he perceives that the dome being exceedingly large, and the object but ſmall, the ſpace which the ſaid object occupies on the dome is nearly a level ſurface; and therefore common perſpective comes near enough to the truth for drawing that ſingle object.

But if the object be large, and the dome ſmall, nothing of this ſort can be applied.

Mr. Kirby has, indeed, propoſed a method to draw perſpective repreſentations upon vaulted roofs and domes; and, for

any thing I know, it is as good a method as can be adopted; yet it cannot be called perfect, much leſs a ſyſtem of linear perſpective applicable to ſpherical ſurfaces *.

But the ordinary rules of perſpective applied to a plane is a perfect ſyſtem, as it relates to the repreſentation of objects according to their real appearance on a tranſparent plane interpoſed between the eye and the original figure of any thing: for the tranſparent plane, in this caſe, is a ſection of the rays of light coming from the object to the eye; which ſection is therefore an infallible and moſt perfect perſpective repreſentation of the original figure on a plane; but it is not ſo perfect to the eye, becauſe the eye is globular.

Perſpective then, as it reſpects the appearance of objects on a plane, is perfect, and its rules are ſtrictly mathematical; but as it reſpects the appearance of thoſe objects to the eye, it is a deception, and is therefore liable to defects and imperfections, as every other deceptive art is, owing to various circumſtances depending on the management of the artiſt. Theſe diſtinctions have not been ſufficiently attended to by ſome, which has therefore been the occaſion of ſome diſputes on this ſubject not well founded.

* As this ſubject is foreign to my purpoſe, and not likely to be of uſe to thoſe perſons I wiſh to ſerve in this work, I ſhall not enter upon it; but if the reader chuſes, he may conſult the third ſection, page 74, of the above gentleman's book.

Hence

Hence it has been ſaid, by a certain writer, that a row of columns, or cylinders, cannot be repreſented parallel to the picture, without producing a clumſy and bad effect, if they be drawn according to the ſtrict rules of perſpective; for then thoſe columns which are furtheſt from the center will be the largeſt, which ought rather to be the ſmalleſt, according to their appearance to the eye. But this depends on circumſtances, and is not a ſufficient reaſon for charging the rules of perſpective with falſity, or even a defect, unleſs the laws of this art obliged us always to chooſe a very ſhort diſtance; and that, when we view a picture, we muſt neceſſarily hold our noſe cloſe to it, before we can be a judge of the merit of perſpective.

From pretty much the ſame principles another gentleman, who writes on this ſubject, gives us an inſtance of the imperfections of perſpective, by repreſenting a geometrical ſquare, with a very ſhort diſtance, which occaſions the ſquare to look too long one way, which he therefore terms a falſe repreſentation, though he has obſerved the ſtrict rules of perſpective. Yet I will venture to ſay, having made the experiment, that if this gentleman had placed his eye perpendicular to the center of the picture, and at a diſtance from it equal to that by which he drew the ſquare, he would not have diſcerned any bad effect even in that which he calls a falſe repreſentation. But that the learner may have a proper view of this ſubject, I ſhall firſt re-

preſent a row of columns as they appear to the eye; and, ſecondly, repreſent the ſame row as they appear on a plane, by which the learner will ſee the difference between Mr. Kirby and Mr. Malton's opinions on the ſubject. And, thirdly, we ſhall ſhow the aforeſaid row of columns on a plane, having the advantage of a long diſtance, which, in this caſe, is recommended both by Malton and Noble; the effect of which being a proof that we may abide by the ſtrict rules of perſpective in delineating a row of columns, or any other cylindrical object, and that more pleaſant to the eye than when they are repreſented according to Mr. Kirby's opinion and definition of perſpective, which is, " to draw the repreſentations of objects as they appear to the eye." See page 94 of his Treatiſe on Perſpective.

Firſt, to delineate a row of columns according to Mr. Kirby's definition.

Of the Repreſentation of a Range of equidiſtant Columns parallel to the Picture.

FIRST, Let I, K, L, M, Plate XX. Fig. 20, be conſidered as a horizontal ſection of the four columns A, B, C, D; and let the arch 1, 2, 3, 4, &c. be the ſection of a ſpherical picture, and *d* the diſtance of the eye from the picture, then will *s* be its center.

ter. Draw from the apparent diameters of each column viſual lines to *d*; and where theſe rays cut the arch at 1, 2, 3, 4, &c. will be the repreſentation of the diameters of the four columns as they appear to the eye. Theſe diameters and their intercolumns, or ſpaces between, muſt now be transferred to a level plane or picture, as in No. 1. Draw a line A B, and take 1, 2, from Fig. 20, and place it at 1, 2, No. 1.; then take 2, 3 from Fig. 20, and place it to 2, 3, No. 1. and ſo of all the others. Draw perpendiculars from each number, and finiſh them, as exhibited in the figure, and they will be the repreſentations of the four columns A, B, C, D, as they appear to the eye.

Secondly, We ſhall now repreſent the ſame columns as they appear on a plane, having the ſame center and diſtance as before. Draw the line P P, Fig. 20, parallel to the four columns, which will be the ſection of the picture; and ſince the viſual rays from each column were drawn before, the repreſentations of the apparent diameters of the ſaid columns on a plane will be at *a b*, *c e*, *f g*, *h i*. Transfer theſe diameters and their intercolumns to No. 2, as the figure ſhews; then will A, B, C, D, be the appearance of the four original columns at Fig. 20, on the plane of the picture, according to the ſtrict rules of perſpective.

Now

Now the queſtion is, Which of theſe repreſentations are moſt alike to the originals in Fig 20? If the reader will place his eye perpendicular over A, the center column in each repreſentation, and look through his hand at a diſtance equal *d s*, Fig. 20, I believe he will be able to determine for himſelf; nevertheleſs it may be proper to offer ſome remarks by way of aſſiſting his enquiries. And, firſt,

We may obſerve that the whole ſpace which includes the columns at No. 2, is conſiderably nearer the length of the originals at Fig. 20. than the ſpace which No. 1. includes. The intercolumns are nearer alike at No. 2 than they are at No. 1. And, laſtly, if we look ſteadily through our hand as above directed, we ſhall find that, at No. 2, the apparent thickneſs of the column D will be greatly reduced, and that of C will be alſo reduced, and both in proportion to their diſtance from the center, ſo that there will not be much difference in the thickneſs of each. But if we look in the ſame manner at No. 1, we ſhall find the repreſentation appear worſe, for D C will appear ſmaller than they are repreſented. The reaſon is obvious, for the rays of light by which viſion is performed, being conſiderably oblique at the column D and C, the optic angles which they ſubtend are much leſs than thoſe ſubtended by A and B, as Fig. 20 clearly demonſtrates; for the rays G *d*, H *d*, are more oblique to

the picture P P than the rays N *d*, O *d*; therefore we ſee that the arch 7, 8 is leſs than the arch 5, 6, and ſo of the reſt in proportion.

The figure alſo demonſtrates, that when theſe viſual rays are cut by a plane P P, parallel to the original columns, the effect is reverſed; for then the repreſentative diameters will increaſe as they decline from the center *s*, yet the optic angles under which they are ſeen remain the ſame as before, when the viſual rays were cut by a ſpherical picture at 1, 2—3, 4, &c.

Hence it is evident, that the diameter *h i*, viewed by an eye at *d*, would not appear larger than the diameter 7, 8 on the arch. Wherefore the true repreſentations of the original range of columns as they would appear on a tranſparent plane, interpoſed between the ſpectator's eye and the ſaid original columns, are at No. 2, not at No. 1, for that is their repreſentation on a ſphere, as they appear to the eye, anſwering to Mr. Kirby's definition of perſpective, though this is not what he means to recommend in practice; for he ſays, page 97, " that they" (meaning a range of equidiſtant columns) " ſhould be ſo repreſented as not to offend " the eye of a common obſerver;" by which he means they ſhould be drawn of one thickneſs, and at equal diſtances. How far the repreſentation at No. 1, which is according to his definition,

tion, will agree to this, I will leave to the judgment of the reader, and ſhall proceed to ſhew how theſe columns may be repreſented, according to the ſtrict rules of perſpective, ſo as to appear of one thickneſs, and at equal diſtances.

We have hitherto ſuppoſed the eye of the ſpectator at *d*, viewing the original columns A, B, C, D, Fig. 20, in which ſituation the viſual ray H *d*, from the fartheſt column D, and the eye's axis *d s*, form an angle of fifty-four degrees; and ſince *s i* is but half the picture, the whole would be ſeen under an angle of one hundred and eight degrees, which is far too great for viewing any picture; for the eye at *d* cannot take in a ſpace twice the length of *s i*, without being ſtrained and twiſted.

To convince the learner of the truth of this, let him take a pair of compaſſes and extend them from *d* to *s*, and placing one foot on the column A, at No. 2, let the other foot keep his right eye from A, exactly at the diſtance of their opening, equal *d s*. Obſerve, the compaſs foot muſt nearly touch the right eye, or the experiment will not be ſo ſtriking. The eye being thus placed, experience will teach him that he cannot ſee the column D at No. 2 without twiſting his eye; and at the ſame time he will ſee, as we ſaid before, that the columns will be nearly equal in thickneſs. But if the eye *d*, at Fig. 22, be removed back to E,

the

the whole picture will be ſeen with eaſe, for it will only ſubtend an angle of forty-eight degrees; and at this diſtance, the viſual rays being not ſo oblique to the picture as before, they will cut it nearly at equal diſtances from each other, as is denoted by the aſteriſms **, where the dotted rays cut PP. The good effect produced on the picture P P, by chooſing E for the diſtance, is clearly demonſtrated by Fig. 21, which exhibits the ſame row of columns drawn by the diſtance E.

Thus:—make *s d*, Fig. 21. half the ſpace of E *s*, Fig. 20; becauſe there is not room for the whole diſtance on the plate. From *s* draw *s* A perpendicular to H L. Draw G R as a ground line, and proceed as before to lay on the ſpaces marked by the aſteriſms **, Fig. 20, on the line P P. Draw then the viſuals from A, B, D, C, as the figure ſhews. From 1, Fig. 23, draw a line to *d*, cutting A *s* in 2. Through 2 draw a line parallel to G R, cutting the viſuals; by which will be repreſented four geometrical ſquares, in which the baſes of each column will be inſcribed. Laſtly, from the circles contained in each ſquare, draw the ſhafts, and finiſh them as in the figure. Now let the reader* place his eye perpendicular over *s*, and at a diſtance from *s* equal twice *s d*; then I am perſuaded he will ſay, that a common obſerver would pronounce the columns of equal thickneſs, and their intercolumns equidiſtant, although they are repreſented according

 to

to the ſtricteſt rules of perſpective; which Mr. Kirby thinks we muſt not abide by in this caſe.

Before I conclude this head, it may be proper to take ſome notice of the repreſentation of a row of equidiſtant pilaſters.

A little reflection will make it evident, that the repreſentation of a row of pilaſters parallel to the picture, are not ſubject to thoſe awkward appearances which columns are, owing to a ſhort diſtance. For,

Let the dark line 9, 10, on the column D, Fig. 20, be a pilaſter, equal in width to 13, 14, on the column A. Draw the viſuals 9, 10, to *d*, cutting the picture P P at 11, 12; then will the ſpace 11, 12 be equal *a b*, cut by the rays from the pilaſter 13, 14; for as the pilaſter 9, 10 is to 13, 14, ſo will 11, 12, *a b*, their repreſentations, be to each other. The ſame reaſoning ſhows us why columns increaſe in thickneſs as they decline from the center of the picture, if we obſerve where the viſual rays, drawn from their apparent diameters, cut the line paſſing through their centers, as *t v*, *k l*; wherefore, as *k l* is to 13, 14, ſo is *h i*, the repreſentation of the column D, to *a b*, the repreſentation of A. And hence it is evident, that in the repreſentations of buildings whoſe fronts are parallel to the picture, their

doors

doors and windows will be to each other as their originals are; that is, if the windows and ſpaces between them be equal in width, their repreſentations will be equal alſo; and, as Mr. Martin obſerves, " all plane ſurfaces whatever, placed in a front wall or plane, will have in their perſpectives no change of figure at all; a ſquare, a parallelogram, a triangle, a pentagon, a circle, an ellipſis, &c. will be all the ſame figures on the perſpective plane, and perfectly ſimilar to the originals; and this will hold good in every part of ſuch a plane in front, as well above and below the horizon, as on each ſide the eye *."

Of the proper Choice of the Diſtance of the Picture, proportioned to the Height of the Horizon, and the Nature of the Object to be repreſented.

FROM what has now been hinted reſpecting long and ſhort diſtances, the learner will naturally wiſh to know ſome fixed principle about it, and what is the general rule for chooſing a diſtance.

To give him all the ſatisfaction I can on this ſubject, I ſhall propoſe the following remarks.

* See his Principles of the Genuine Theory of Perſpective, page 51.

There is a certain diſtance ſhorter than which the eye cannot eaſily ſee a picture; and therefore if an object be delineated by ſuch a diſtance, it will appear unnatural.

In Plate XIV. Fig. 1, let B D be the length of the picture, and Z the place of the ſpectator's eye, and *e* the center of the picture, then will Z *e* be the diſtance of the picture; but as Z *e* is very little more than half the length of the picture B D, therefore the angle under which the whole picture would be ſeen at Z, is almoſt ninety degrees.

This is an angle which the eye cannot eaſily take in, becauſe the ray Z B is in a ſtate too diverging to the pupil of the eye, and therefore the ſpectator muſt twiſt and ſtrain his eye, before he could ſee the whole extent B D.

The optical reaſon of this is as follows:

Produce the viſual rays L P, K P. Now, it is evident, from the ſcale on the arch, that theſe rays ſubtend an angle of more than ninety degrees. Therefore ſince, according to optical laws, rays will not unite in a point on the retina at a greater obliquity than an angle of forty-five degrees, conſequently the points K L will not appear to the eye. This is probable enough from the figure

figure of the eye, for the image *s* of K, and *o* of L, are too far forward in the eye to be ſeen; but by turning the eyes a little towards K or L, it is evident they will become viſible; for then P *e*, the axis of the eye, will perhaps be turned to 20; or, on the other hand, at 40; conſequently the angle of obliquity 20, P K, being conſiderably leſs than forty-five degrees, the pencil of rays from the point K will unite in a point on the retina, and ſo become viſible.

A ſimple experiment will convince the reader of the truth of this. Take a lath two feet long, and at the center fix a wire in a perpendicular direction, about thirteen inches long, or we ſhall ſay twelve inches, for then a thread ſtretched from the wire to each end of the lath would form an angle of 90; that is, the threads will be perpendicular to each other. The end of the wire being held cloſe to the eye, the experimenter muſt look along each thread at once, and try if he can ſee them diſtinctly at each end of the lath at the ſame glance, without ſtraining his eyes. If he continue to do ſo a few minutes, the pain which this gives will be a ſufficient proof that the eye cannot eaſily take in an angle of 90; and that therefore twelve or thirteen inches is far too ſhort a diſtance for a picture two feet long.

Therefore,

Therefore, in Fig. 1, if the eye be removed to P, the angle which the rays D P, B P make with the picture B D is conſiderably leſs, and hence the eye at P will more eaſily take in D B, the whole extent of the picture; becauſe the rays D P, B P do not diverge ſo much at the pupil as before. If, therefore, the aforeſaid wire be lengthened in the proportion of P *e* to B D, which will be as twenty-one inches are to twenty-four, the whole length of the lath; and if threads be fixed as before, repreſenting the viſual rays D P, B P, the eye P, placed at the end of the wire, will eaſily ſee at one glance both the threads B D.

This experiment, therefore, induces me to conclude that a picture which is filled the whole length with objects on the front, ſhould never be drawn by a diſtance ſhorter than the perpendicular of an equilateral triangle, whoſe ſides are equal to the whole length of the picture. The angle B, P, D, is equilateral, and P *e* is its perpendicular; and that I take to be the ſhorteſt diſtance that ſhould be uſed in this caſe. And I will venture to affirm, from experience, that any perſon who has never once thought on this ſubject, when viewing a picture two feet long, will not ſtand leſs than twenty-one inches from it when he wants to ſee the effect of the whole; but if he would examine minutely ſome particular part ſeparately, he will naturally

turally approach nearer to the picture, in proportion to the ſize of the part thus examined. Whence, I alſo conclude, if nature is to be a guide in matters of delineation and painting, that the diſtance of the picture ſhould be as 21 is to 24, ſo is the proper diſtance to the ſpace which the front objects occupy on the picture. For, ſuppoſing a picture two feet long to have only two or three regular objects on the front, occupying not more than two thirds of the whole length, which is ſixteen inches, it would not be neceſſary in this caſe to make the diſtance twenty-one inches. A diſtance of fourteen or fifteen inches would then be ſufficient, and produce a more agreeable effect in the appearance of the regular objects, both in front and back, than when drawn by a much longer diſtance. For, if front objects are too much fore-ſhortened by a long diſtance, thoſe on the back ground will be much more ſo, and appear too tall for their thickneſs; and the whole picture will want depth, eſpecially if it be an internal view of a ſtreet, a long room, or any thing of this nature, where the eye is ſuppoſed to be pretty near the firſt object.

I ſhall now apply the foregoing principles to a few practical caſes, by which the learner will ſee the effect of long and ſhort diſtances, and how to chooſe them on particular occaſions.

How to chooſe a Diſtance, when the whole Length of the Picture is filled with Objects on the Front.

LET *p r*, *o t*, Fig. 22, Plate XX. be the lines which mark out the length of the picture filled with ſquares on the front.

Extend the compaſſes from *v* to *v* on the horizon, and ſweep the arch *v* D, D *v*; then will their interſection D be the proper diſtance in this caſe, and *s* will be the center. Make *s* V each way equal *s* D, and V will be the working diſtance, as the figure ſhows.

The ſquares C, K, N, O, drawn by the diſtance *s* V, are perfectly natural. But the ſquares E, P, Q, R, drawn by *s v*, are not ſo; becauſe the diſtance is vaſtly too ſhort; for the eye at *d* views the picture in an angle of ninety degrees, which, as we have already ſhewn, is far too great, and therefore the repreſentation of the ſquares are unnatural to a common obſerver. But if the reader place his eye perpendicular to *s*, and at a diſtance from *s* equal *s d*, he will find that the unnatural length of the ſquares, from front to back, will be greatly diminiſhed in appearance.

On the other hand, it is equally neceſſary to avoid chooſing a diſtance too long; the effect of which is ſeen at the ſquares F, where they appear too narrow from front to back; for the diſtance at *z* forms, with the whole length of the picture, an angle only of 48 degrees; which ſhould not be admitted, except in particular caſes, as in the repreſentation of a row of columns parallel to the picture in Fig. 20, where the eye at E is in the ſame angle with the picture twice PP, as at *z*, Fig. 22.

How to chooſe a Diſtance, when the Objects are drawn by a large Scale, ſituated not far from the Center of the Picture.

LET *p t*, Fig. 22, ſtill be conſidered the whole length of the picture; and let M be the repreſentation of a ſquare, on a much larger ſcale than that at C; and let its ſituation at M be much nearer to F, the center ſquare. From *s*, the center, extend the compaſſes to *t*, the extreme point of the picture, and ſweep the arch *t*, *c*, *b*, then will *c* or *b* be a proper diſtance in a caſe of this kind; for the ſquare M, drawn by the diſtance *c*, appears perfectly natural, which would be too long were it drawn by V, the former diſtance, as appears by the diagonal drawn from 10 to V, cutting the viſual 9, *s* at *a*. This by no means contradicts what has been advanced in page 178; where we ſay, that " a picture filled with objects on the front, ſhould never be drawn by a

diſtance ſhorter than the perpendicular of an equilateral triangle, whoſe ſides are equal to the whole length of the picture." For, let the line 9 be now conſidered the bounds of the picture, and it will be evident, by drawing a line from *b* to *g*, that the diſtance *s b* is greater to the picture at 9, than *s* D is to the picture at *t*, otherwiſe *b g* would be parallel to D *v*.

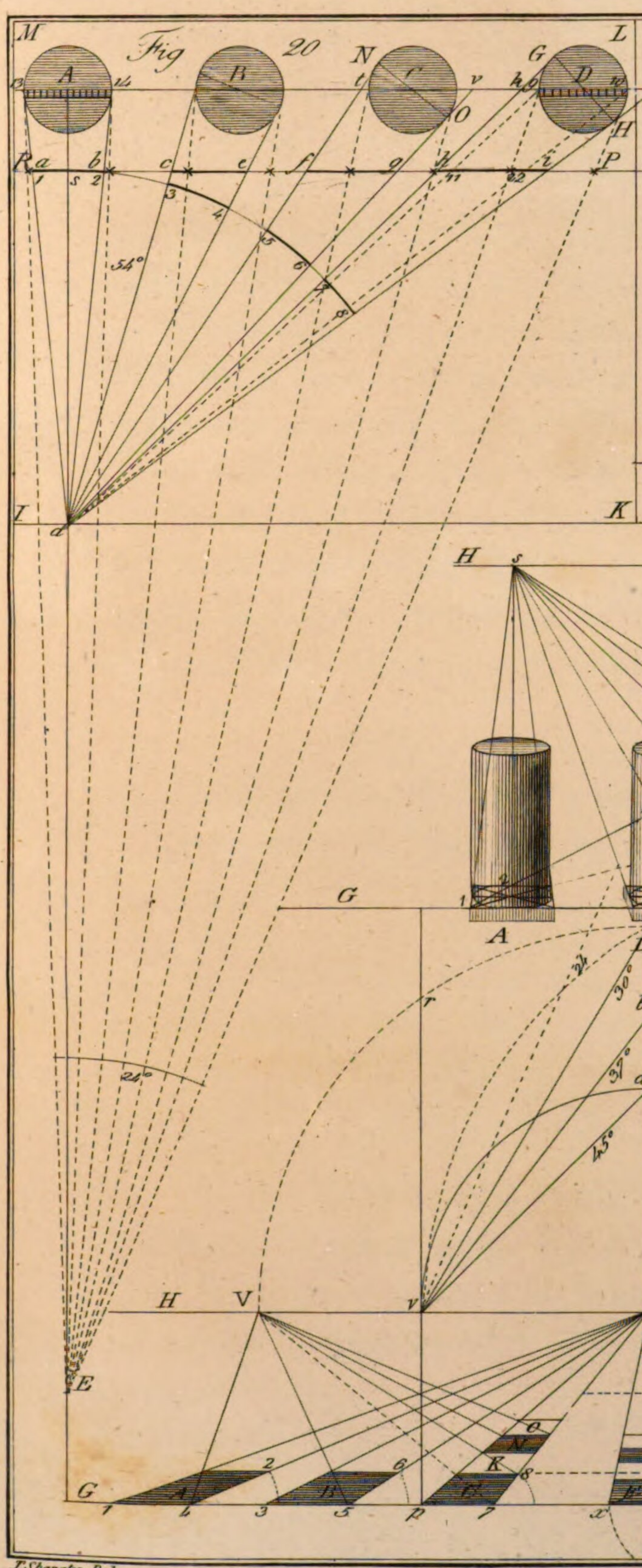
Another advantage may be obſerved in this method, if we conſider that a very high horizon will produce as much diſtortion in a picture as too ſhort a diſtance. Therefore if we ſuppoſe the horizon to be made higher by the ſpace *t i*, the diſtance will then be *s i*, in the ſame proportion to it as *s c* is to *s t*.

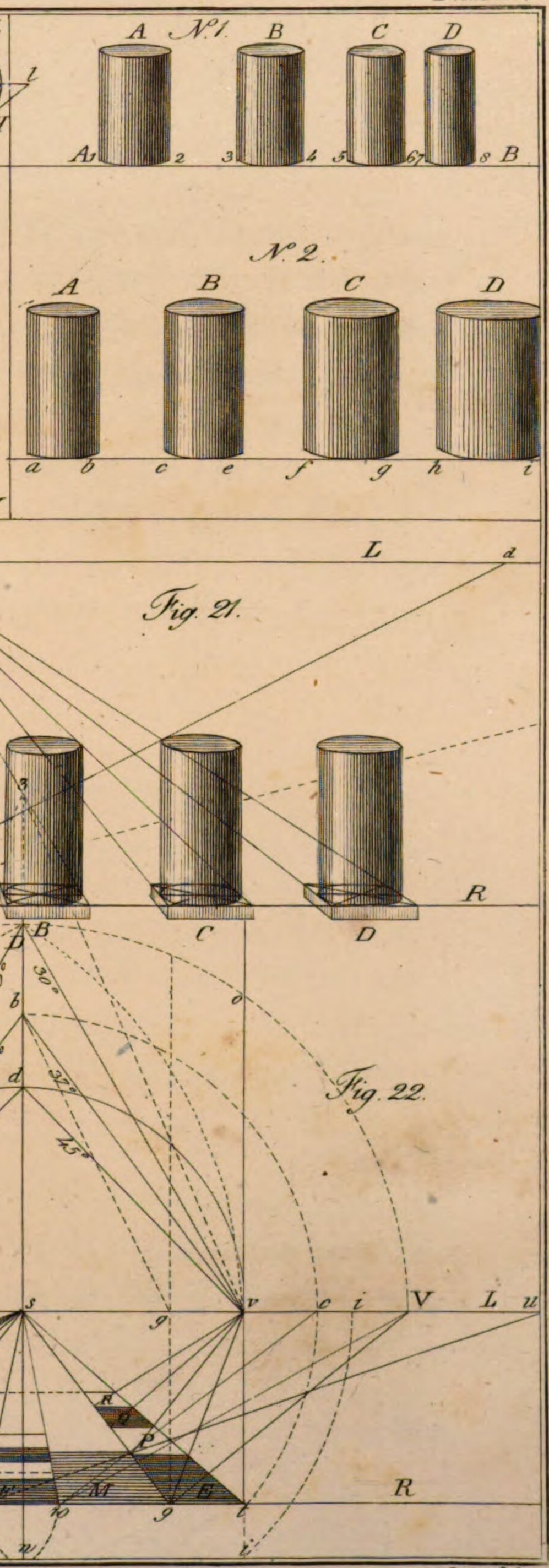
How to chooſe a Diſtance, when a Piece of Furniture, not very long, is repreſented by itſelf on the Center of the Front of the Picture.

If a ſingle object, or piece of furniture, be repreſented by itſelf on the center of the ground line, an equilateral triangle being drawn, whoſe ſides are equal to the length of the piece of furniture, the perpendicular of this triangle added to the height of the horizon, will be a very agreeable diſtance in ſuch a caſe. Thus, at the ſquare F, ſuppoſed to be the plan of a piece of furniture repreſented on the center of the ground line, extend the compaſſes from 10 to *x*, and ſweep the arches, to form an

equilateral

Fig 20





N°. 1.

N°. 2.

Fig. 21.

Fig. 22.

T. Sheraton. Del.

Barlow sculp.

Published as the Act directs by T. Sheraton Dec.r 20.th 1792.

equilateral triangle, whoſe perpendicular will be at *w*; then will *s w* be the diſtance propoſed in this caſe. But if the piece of furniture be of an extraordinary length in front, in proportion to its breadth from back to front, then it will be beſt to adopt the preceding method; for if we ſuppoſe the piece of furniture to extend from 7 to 9, then a perpendicular of an equilateral triangle of that dimenſion added to the whole height of the horizon, would foreſhorten too much. Of theſe things I am perſuaded the reader will be convinced, if he make the experiment as the caſes are here ſtated.

Of the Repreſentations of circular and curvilinear Figures, both plain and ſolid; together with ſome Remarks on their Theory.

The manner in which ſome painters and deſigners treat circular objects, would lead one to ſuppoſe that there is no certain theory on which to build the practice of drawing objects of that kind.

Sometimes we may ſee a caſk, if not ſhewing both ends, yet the end on which it ſtands is repreſented by a curve conſiderably more flat than that by which its top is ſhewn; than which nothing can be more abſurd, for the very reverſe is the truth.

We may alſo ſee, in ſome cabinet deſigns, the bottom of a round fronted cheſt of drawers, or commode, repreſented by the ſame curve as that which repreſents the top part; which, though not ſo ridiculous as the above, is far from being ſcientific, or according to the rules of perſpective. That the learner may avoid theſe miſtakes, and have a proper conception of this matter, we ſhall propoſe the following ſhort theory.

Caſe 1.—If an original circle be ſituated in a plane parallel to the picture, its repreſentation will be a circle.

Thus:—Let A, B, O, D, Plate XIX. Fig. 20, be an original plane parallel to the picture H, I, K, in which is ſituated a circle *a*, *b*, *d*, *e*, whoſe repreſentation on that picture is required.

The viſual rays from each diameter of the original circle tending to the eye E, are cut by the picture or plane of projection H, I, K, in a parallel direction to the original plane A, B, O, D. Wherefore we have the diameter 4, 2 drawn perpendicular to *a d*, its original. Alſo we have the diameter 1, 3 parallel to its original *b e*; conſequently the diameters 1, 3—4, 2, are the repreſentations of their originals *a d*, *b e*. C is the center of the original circle, and a line from C to E biſects the triangle *b*, E, *e*; conſequently *c* is the repreſentation of the center C. Laſtly, the radii or ſemidiameters *c* 1, *c* 2, *c* 3, *c* 4, are equal and ſimilar to their originals,

originals, and therefore any one of them, as *c* 1, will deſcribe the circle 1, 2, 3, 4, which will be the true repreſentation required. The truth of this may alſo be proved, by conſidering the viſual rays *b* E, *d* E, &c. as the ſides of a cone whoſe vertex is at the eye E, and whoſe baſe is the original circle *a*, *b*, *d*, *e*, and its axis C *c*. Now it is evident, that if a cone have a ſection parallel to its baſe, the curved boundary of that ſection is a circle, in like manner as a pyramid, whoſe baſe is a geometrical ſquare, produces a geometrical ſquare, if its ſection be parallel to its baſe. See page 230. Plate XV. Fig. 6.

By the above theory we ſhall eaſily judge how to proceed in the repreſentation of arches, when they reſt on pillars or piers parallel to the picture. And it ſhould be obſerved, that in whatever ſituation the original arch or circle may be in with reſpect to the center of the picture, if they be parallel to the picture, their repreſentations will be ſimilar to their originals *.

Caſe 2.—If an original circle be ſituated in a plane not parallel to the picture; that is, if it be the repreſentation of a circular object lying on the ground, or in any plane parallel

* The reader may, if he pleaſe, conſult Dr. Brook Taylor's ſecond corollary of theorem fourth, p. 16.

with it, its repreſentation on the picture will be an ellipſis. The reader who has previouſly made this ſubject his ſtudy, may aſk what I mean by the term ellipſis in this place? ſince ſome have diſputed whether the repreſentation of a circle in the above caſe be a regular ellipſis, or a curve of ſome other ſpecies of the conic ſections. Mr. Noble has diſcuſſed this point in oppoſition to the critical reviewers, who had cenſured Mr. Ware in his tranſlation of Sirigatti's perſpective, becauſe the tranſlator had defined the repreſentation of an original circle ſituated in a plane not parallel to the picture, to be a regular ellipſis. In oppoſition to which definition of Mr. Ware's, the Critical Reviewers for July 1756, page 509, make the following obſervations.

"In regard to his regular ellipſis for the repreſentation of a circle, it appears, from the very nature of perſpective, that the fore part of a circle will appear more round than the back part, which being further removed from the eye, cannot appear to have the ſame degree of curvature; and conſequently the whole figure, if drawn, muſt be very far from having the form of ſuch an ellipſis as is to be made by a tranſverſe and conjugate diameter."

Mr. Noble, in oppoſition to the above remarks, attempts to prove that the repreſentation in queſtion muſt be a regular ellipſis; but his arguments are ſo abſtruſe, that if they were

founded in truth they would not be convincing to the ordinary reader, and therefore I ſhall not trouble him with them, but proceed to offer a remark or two in confirmation of thoſe made by the Reviewers, which I think eaſily underſtood. Let A, B, C, D, Plate XXI. Fig. 23, be the repreſentation of a geometrical ſquare in which an octagon and circle may be inſcribed. The circle, truly repreſented, will touch every ſide of both the ſquare and octagon, as ſhewn by the figure. Now, I cannot ſee by what mode of reaſoning we can prove that the ellipſis is regular any more than we can prove that the octagon is regular, becauſe it is the repreſentation of one that is ſo; but, perhaps, to uſe Mr. Noble's words, "we are ignorant of thoſe few geometrical præcognitæ which alone can render us capable of conviction on this point:" and this may be the reaſon why I have conſidered Mr. Noble's arguments ſo abſtruſe*. At the ſame time I do not think the Reviewers were ignorant of thoſe few firſt principles of geometry, nor even wanted their recollection, when they animadverted on Mr. Ware. They juſtly ſay, "that the fore part of a circle will appear more round than the back part," which muſt be evident to every one, by obſerving that the whole curve on this ſide of the diameter *g c*, is what they mean by the fore part of the circle,

* The reader, if he chooſe, may ſee the arguments in Noble's Linear Perſpective, page 142.

and

and all beyond *g c* is conſidered the back part of it. We may alſo obſerve, that the curves contained in the quarter parts of the ellipſis are not one of them ſimilar to another. How then can we pronounce it a regular ellipſis? When we ſpeak of the perſpective appearance of any original object, do we not denominate it by the figure which it aſſumes upon a plane, and not as it appears to the eye? where then is the good ſenſe or propriety of calling that a regular ellipſis which is no way regular? One would think Mr. Noble had forgotten the diſtinction which he ſo properly maintains in other parts of his book, namely, between the appearance of objects to the eye, and their repreſentation on a plane; for if we ſtand at a diſtance from the top of a round table, it will appear to the eye a regular ellipſis; but if the top be repreſented on a picture according to that diſtance, it will be an irregular ellipſis, and its irregularity will be in proportion to the ſhortneſs of the diſtance of the picture. But ſuppoſe we were to conſider *b d* the tranſverſe diameter, and conſequently *b f* the conjugate, yet there is a manifeſt difference between the two ſemi-ellipſes. Nor is it poſſible to draw a tranſverſe diameter in ſuch a direction, as when the two ſemi-ellipſes are turned down on each other that they would coincide. Yet it muſt be obſerved, that if the repreſentation were drawn in the center, and by a long diſtance, it would, in this caſe, approach ſo near a regular ellipſis as the difference could not be eaſily diſcerned.

From

From what has been ſaid, the learner muſt obſerve then, that when he proceeds to draw the repreſentation of an original circle, he muſt not think of applying the compaſſes or trammel to draw it by; but a number of points muſt be found, through which the path of the ellipſis muſt be directed by a hand ſuperior to his who only can draw an ellipſis by a trammel or compaſſes.

Of the Repreſentations of circular and curvilinear Figures, both plain and ſolid.

PROB. XIX. FIG. 23. Plate XXI.

To repreſent a Circle lying on the Ground Plane, or when it is ſituated in any Plane parallel to the Horizon.

OPERATION.—Let H L be the horizon, and G R the ground line, *s* is the center of the picture, and *d* its diſtance. Make *s v* equal *s d*, and draw *d* V at right angles to *d v*, then will *v* V be the vaniſhing points to four ſides of the octagon. Make V M equal V *d*. Likewiſe make *v m* equal *v d*, and M *m* will be the true meaſuring points. Draw a half plan of an octagon, as was ſhewn in Problem XVII. and Fig. 18. Make A D equal to the diameter of the given circle. Draw the viſuals 2 V, 1 *v*, indefinitely.

finitely. Make 2 P, 1 *l* equal 2 *q*, the ſide of the octagon; and draw from *l* and *p* meaſuring lines to their reſpective points M *m*, cutting at 3 and 8. From 3 and 8 draw 3 *s*, 8 *s*. Take the ſpace 1 D, and lay it from D to 10, and from A to 12. From 12 draw a line to V, cutting at 7, 6. From 10 to *v* do the ſame, cutting at 4, 5. Laſtly, draw 5, 6 parallel to 1, 2, and the octagon in which the given circle is to be inſcribed is completed.

Method ſecond.—In this method, which is very ſimple, we proceed without regard to any of thoſe lines uſed in the firſt method, which was more ſcientific, and according to Dr. Brook Taylor's ſyſtem. The ground plane F is ſuppoſed to remain as before. Let A, B, C, D, be the repreſentation of a geometrical ſquare, found by the diagonals paſſing to each vaniſhing point, conſequently S will be the center. Through S draw *g c*, and draw *a s*, from which we have four points, *a*, *g*, *e*, *c*, of the intended circle. Draw a line from 2 to V, and from 10 to *v*, cutting the diagonals at *b*, *d*, whence we have two more points. From the points *b* and *d* draw parallel lines, cutting the diagonals in the points *b f*, adding other two; which in all make eight points, ſufficient for the repreſentation of the given circle.

N. B. A quarter plan F is ſufficient for this method.

Method third.—Draw the quarter plane of the circle to be repreſented, contained in the ſquare A, E, *a*, O. Draw the diagonal O A; and from the point *n*, where the diagonal cuts the arch E *a*, raiſe a perpendicular to *t*. Repreſent a ſquare as before, drawing its diagonals each way. From *t* draw a viſual to *s*, cutting the diagonals in the points *h f*. Laſtly, from the points *h* and *f* draw parallels to the other diagonals, cutting at *b* and *d*, by which method there will be eight points gained as before. This laſt method being ſo ſimple, and totally diveſted of every thing that can any way perplex the learner, it has been adopted in the following problems, and in moſt of the repreſentations in this book. There are, however, various other methods of effecting the ſame thing, which might prove more pleaſing to men of ſcience, but which would not be ſo advantageous to the workman, nor even to the artiſt, with whom facility and diſpatch are principal objects.

PROB. XX. FIG. 24. Plate XXI.

To repreſent a Circle ſituated in a Plane perpendicular to the Ground Plane.

OPERATION.—Let the line R be the ground line, and L the horizon, *s* is the center of the picture, and *s d*, on the vertical line, the diſtance. Draw half the original circle B, *n*, C. Draw

the diagonals *o* D, *o* A; from A and D repreſent a geometrical ſquare, by drawing a line from A to *d*, cutting at F. From 1, 2, draw parallels to 3, 9; and from 3, 9, direct viſuals to the center *s*, and the diagonals of the ſquare will be cut at 8, 5, 6, 7, forming four points, by which the repreſentation of the circle may be correctly drawn.

PROB. XXI. FIG. 25. Plate XXI.

To repreſent a Cylinder erect on the Ground Plane.

AFTER what has been ſaid on the preceding problem, it is ſcarcely neceſſary to ſay any thing on this; and therefore I ſhall only obſerve, that having drawn the baſe of the cylinder by the ſame method as in the laſt, proceed to raiſe perpendiculars from A, B, D, C; and from *a* draw *a b* parallel to A B, at a diſtance from A B equal to the original length of the cylinder. From *a b* repreſent another ſquare, as *a*, *b*, *c*, *q*. Draw its diagonals and diameters. From the point 4 raiſe a perpendicular till it cut the diagonal *b c*. From the point 7 raiſe one till it cut the diagonal *a q*. Do the ſame at the points 6 and 5, and eight points will be found at the top correſponding with thoſe on the baſe, by which the cylinder may be completed.

PROB. XXII. FIG. 26. Plate XXI.

To find the Repreſentation of a Cylinder lying on the Ground, whoſe Sides are oblique to the Picture.

OPERATION.—Draw the ground line and horizon as uſual; and let *s* be the center, and *d* the diſtance of the picture. Make *s v* equal *s d*, and from *d* draw *d* V at right angles to *v d*, then will *v* V be the vaniſhing points of the ends and ſides of the cylinder. Make a half plan of the baſe of the cylinder at *a*, *b*, *c*, *d*, as in the preceding caſes. Draw C A perpendicular to the ground line, and equal to the diameter of the cylinder. Draw the viſuals C *v*, A *v*, and C V, A V. Make C F equal C A, and C S equal to the given length of the cylinder. Draw F *m*, S M, cutting at D and 3. Draw D B perpendicular to the ground line, and we have a ſquare in which the end of the cylinder is to be inſcribed. In like manner repreſent a ſquare at the other end, as 1, 2, 3, 4; and having drawn the diagonals and diameters of both ſquares, draw parallel lines from 5, 6 to *e f*. From *e* and *f* direct viſuals to V, cutting *g* and *h*; from *e*, *f*, *g*, *h*, draw viſuals to *v*, which will cut the diagonals of each ſquare in four points, by which each end of the cylinder may be completed.

N. B.

N. B. A circle or cylinder may be repreſented without drawing a plan, by dividing the given diameter *c a* into ſeven equal parts, one of which will cut the diagonals as before, at leaſt near enough for practice.

PROB. XXIII. FIG. 27. Plate XXI.

To find the Repreſentation of a ſemi-ellipſis, whoſe tranſverſe Diameter is parallel to the Picture.

OPERATION.—Draw the ground line and horizon as in common, and let *s* be the center, and *d* the diſtance of the picture. Make then a plan of the ſemi-ellipſis, whoſe tranſverſe diameter is D G, parallel to R, the ground line. Draw A B, including half the conjugate diameter. Draw the diagonals O B, O A, cutting the ellipſis at P and N. Divide A D at K, and draw E F. From E, P, N, F, O, raiſe perpendiculars to the ground line at 4, 5, 6, 7, 8, 9, 10, and from each of theſe draw viſuals to *s*. Make 3, 2, 1, each reſpectively equal A, K, D; and from 1, 2, 3, draw lines to *d*, the diſtance, cutting at *a*, *k*, *b*. From *a*, *k*, *b*, draw parallel lines to *g*, *l*, *c*; and laſtly, draw *o a*, *o g*, then will the ſeveral viſvals be cut at the points requiſite for deſcribing the elliptic curve, as the dotted points in the figure ſhow.

PROB.

PROB. XXIV. FIG. 28. Plate XXI.

To find the Repreſentation of an elliptic Segment inverſely.

SUPPOSE A, B, C, D, to be the ſhelf of any table, &c. hollowed in front in the figure of an elliptic ſegment, A, 1, 2, 3, 4, D. Having drawn one ſide A, 1, 2, 3, 4, of the given ſegment at pleaſure, divide the curve into four equal parts, and from 1, 2, 3, 4, raiſe perpendiculars to *a*, *b*, *c*, *f*; then, to make the other ſide of the curve ſimilar to that already drawn, lay on the ſeveral diviſions *f*, *c*, *b*, *a*, to the right hand, and from theſe let fall perpendiculars at pleaſure; then, from 1, 2, 3, draw parallel lines, cutting the correſponding perpendiculars on the right hand, by which the other half of the ſegment may be accurately drawn. The plan being thus prepared, draw viſual lines to *s*, the center, and make *d* the diſtance. At *a* fix one foot of the compaſſes, and extend the other to 1, and with it ſweep the firſt arch; and in like manner ſweep the arches 2, 3, 4. From the ſeveral points where thoſe arches cut the line A D, direct lines to the diſtance, cutting the ſeveral viſuals at the points 1, 2, 3, 4. Laſtly, from 1 draw a parallel to 7, from 2 draw one to 6, and from 3 draw one to 5; thus will ſeven points be found through which the path of the repreſented curve muſt paſs.

SECTION

SECTION V.

The Application of the preceding Problems to the Practice of Drawing the Repreſentation of Pieces of Architecture, and particularly various Pieces of Furniture in different Poſitions to the Picture.

THE preceding problems, and the various figures referred to, muſt be conſidered as only laying the foundation for the repreſentation of more compound objects, conſiſting both of right and curvilinear parts. It becomes neceſſary, therefore, to ſhew the moſt eaſy application of theſe problems in a variety of examples, that the whole may appear practical and uſeful, and that we may alſo ſee the real effect of that art which we have hitherto laboured to underſtand. Nor do I think that perſpective could well be applied in many caſes without ſuch examples. Beſides, the uſefulneſs of having a few proper examples always ready to turn to, muſt be of conſequence to thoſe who but ſeldom repreſent things in perſpective; in which caſe the rules and methods will frequently eſcape the memory, and make it neceſſary to have recourſe to the book; and for the ſake of more readily finding the explanation of each example, the page of letter-preſs where the explanation begins, is engraved on the copper-plate, it being a practice ſometimes

to

Fig 23

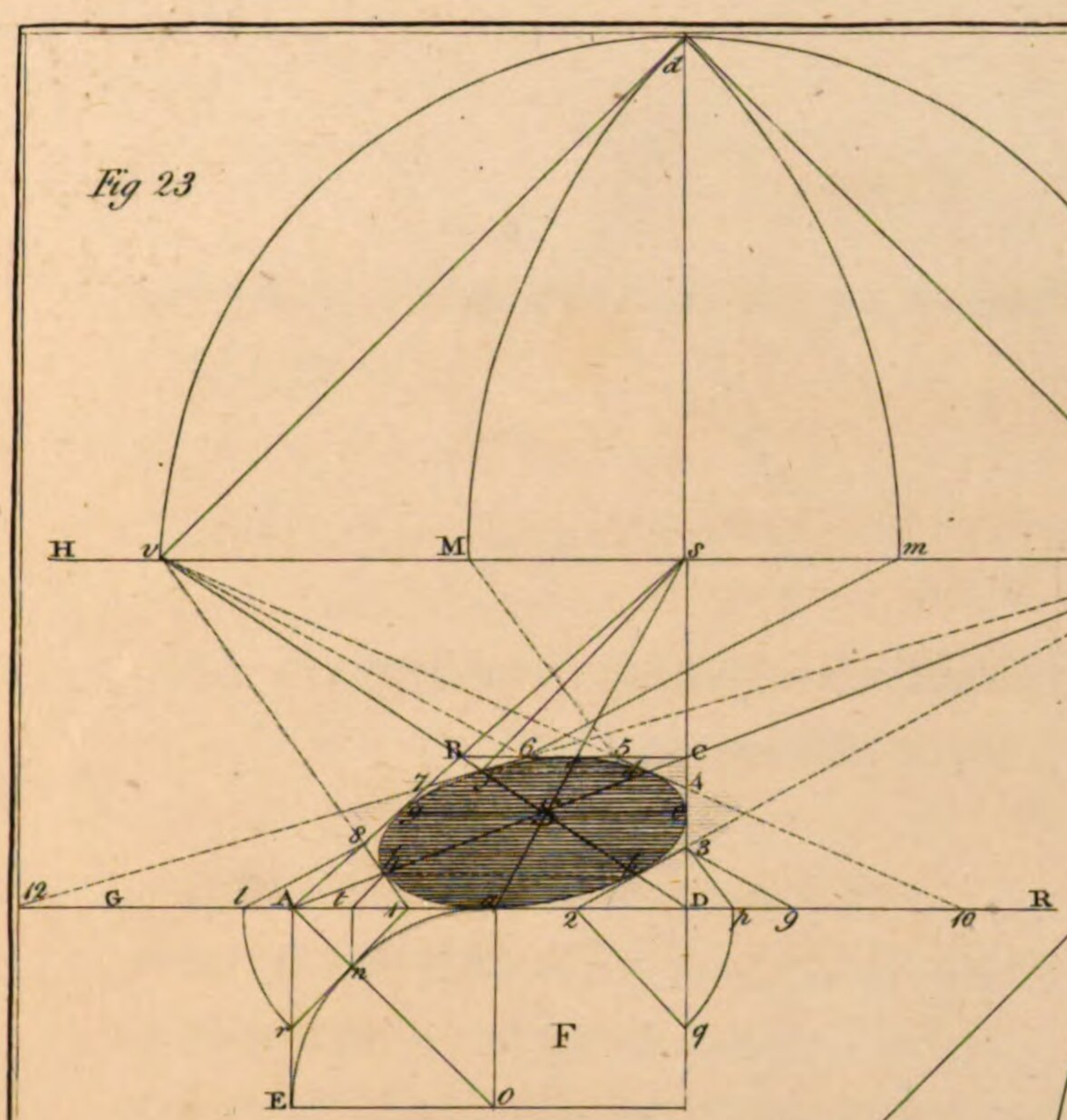


Fig 24

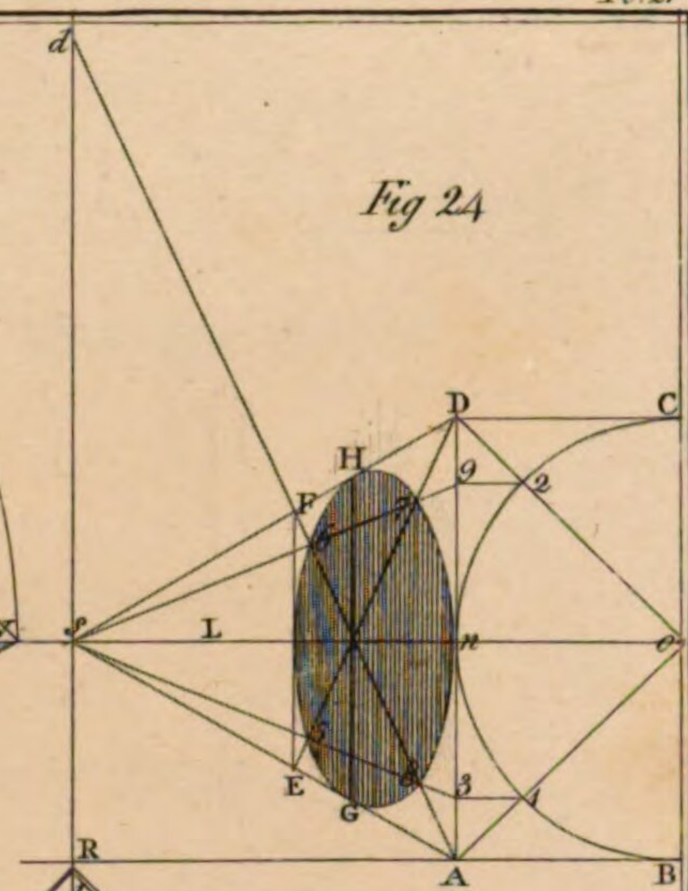


Fig 26

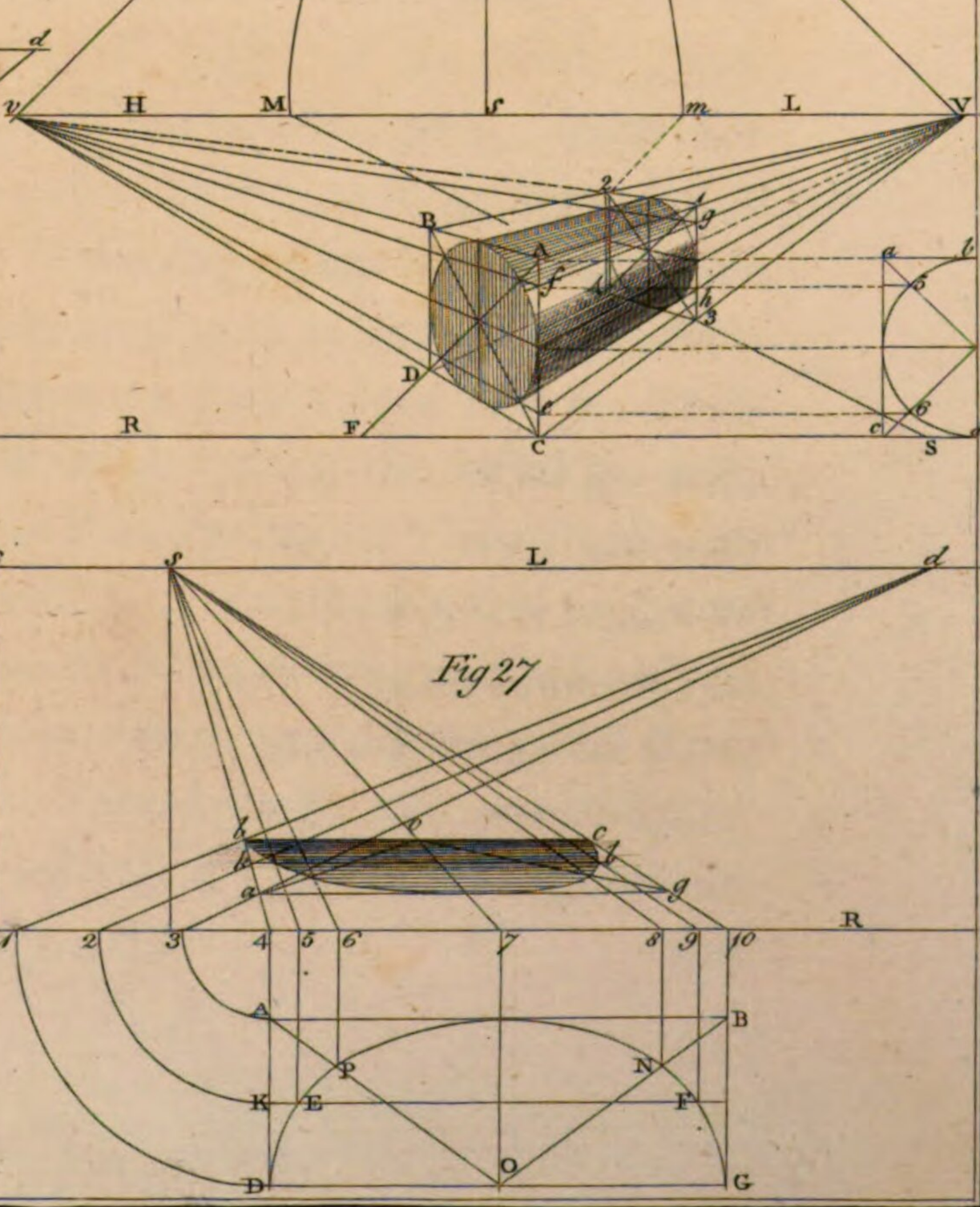


Fig 25

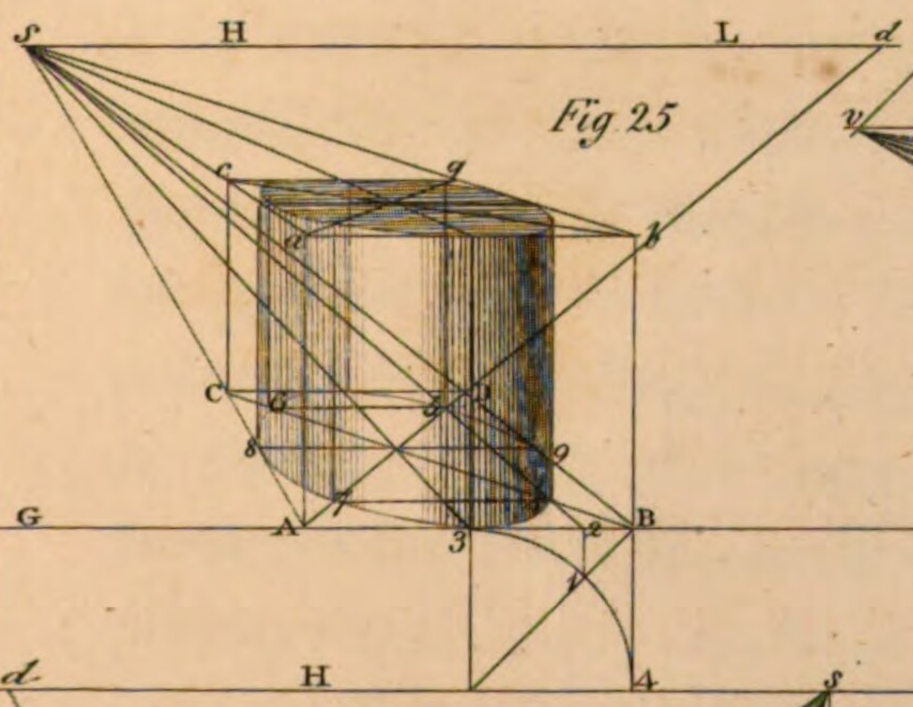


Fig 28

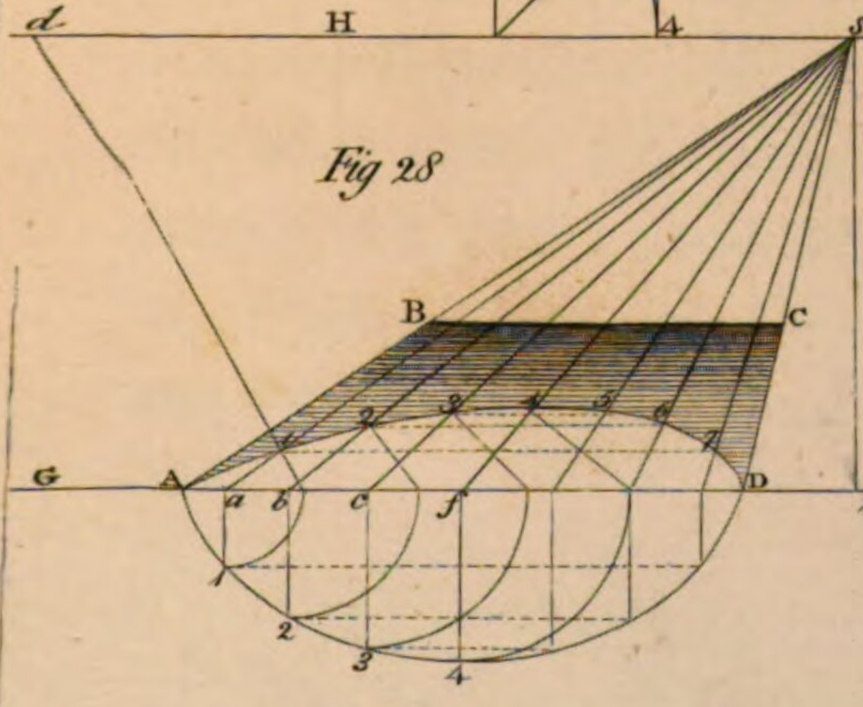


Fig 27

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to look at the plates firſt for an example of what we intend drawing.

Example I. Fig. 29. Plate XXII.

How to repreſent a receding and returning Flight of Steps whoſe Riſers are parallel to the Picture.

Let HL be the horizontal line, *s* the center, and *d* the diſtance of the picture; GR is the ground line. Make AB on the ground line equal to the original length of the ſteps, and draw AE perpendicular to the ground, and make the ſpaces AF, FN, NO, and OE, equal the original height of the riſers. Draw viſuals from each of theſe diviſions tending to *s*. Draw FT parallel to AB, and from B and T draw lines to *s*. Next, lay on the ground line the breadth of the ſtep, from B to *a*; and from *a* draw a line to *d* the diſtance, cutting at *k*; raiſe a perpendicular from *k*, cutting at *n*; and from *n* draw a parallel to *p*. Then from *p* raiſe a perpendicular to *q*, cutting the viſual N*s* at *q*; draw a parallel to *r*, and from *r* a viſual to *s*. Then from *a* to *b* lay the breadth of the ſecond ſtep, and draw a line to *d*, cutting at *m*; raiſe a perpendicular from *m* to *u*, and draw a line from *u* to *s*, and a parallel from *u* to *w*, cutting the viſual C*s* at *w*. Laſtly, lay on from *b* to *e* the breadth of the half ſpace, and from *e* draw a line to *d*, cutting at 5, and raiſe a perpendicular

cular to *x*, and from *x* a parallel; which will complete the firſt flight.

The returning ſtep leading to the ſecond flight is next to be conſidered.

For this, draw the perpendicular *y*, 7, 8, 9, 10, at a diſtance from A equal to the width of the returning ſteps; draw the line 6, 7, parallel to Y A, and at 6 there is an allowance made for the bearing of the ſtep; alſo at Z there is an allowance for the other half ſpace to reſt on. Draw the viſuals R *s* and E *s*; and how to complete the reſt of the ſteps muſt be evident from the figure. The returning flight comes forward until it is in the ſame plane with A B, the firſt riſer; therefore, after having placed the original height of the riſers at 8, 9, 10, and drawn from theſe diviſions viſuals to *s*, it remains only to lay on the bearing of the ſteps at 1, 2, tending to the diſtance, and cutting at 3, 4. Theſe being traced along the ſteps, as ſhewn by the dotted lines, till they cut the viſuals 7 *s*, R *s*; how to perform the other part will appear obvious. N.B. The laſt ſtep of the returning flight 10, 12, does not all come into the plate, otherwiſe its length would be equal A B, the original length of the ſtep. Theſe ſteps might have alſo been repreſented oblique to the picture; but as I have not plate-room for ſo many examples, the learner muſt try if he can do it himſelf, by reflecting on

what has already been ſaid and done on objects in oblique ſituations; but if he fail in his attempt, he may conſult Mr. Malton's complete treatiſe, in its practical part.

EXAMPLE II. FIG. 30. Plate XXII.

How to repreſent a Tuſcan Pedeſtal and Baſe parallel to the Picture.

DRAW A firſt, the profile of the pedeſtal and baſe, which is taken from the large module of the Tuſcan order in Plate VIII. Let H L be the horizon, and make *s* the center, and *s d* only half the diſtance of the picture, for want of room on the plate. Make G R the ground line, and on it, from B to C, lay a ſpace equal to the length of the original plinth. Draw from theſe, lines to *s*. Next, conſider how far the pedeſtal is to be repreſented from the picture, which in this example is equal twice C D; becauſe the whole diſtance is equal twice *s d*. Therefore, from D draw a line to *d*, cutting at F. Make D E equal half B C, cutting at I. Draw F K and I O parallel to B C, by which a ſquare will be repreſented equal to the plinth. Proceed now to repreſent the projection of the ogee or baſe of the plinth. For this, take *o*, 1, half the original projection of the plinth, and place it from B to 2. From 2 draw a line to S, cutting at 3; and from 3 draw one to *d*, the diſtance, cutting 4. Draw next

the diagonals K I, F O. From 4 draw a parallel line, cutting the diagonals at 8, 5, and from 5 draw a line to *s*, cutting at 6; then will be projected each miter of the plinth, and alſo the ſize of the dado will be determined at the ſame time. Therefore from 8, 5, and 6, raiſe perpendiculars at pleaſure, which will ſerve both for the angles of the dado and the plinth of the baſe. From *o* draw a line to *s*, which will cut the parallel produced from 8 at 5, and will give an internal miter at 5, K; raiſe perpendiculars from 5, K at pleaſure. From *c* and 12 on the profile, draw lines to *s*, cutting the perpendiculars raiſed from 5, K at *f*, *m*, which will give the correſpondent miter to 5, K. Draw the projecting diagonals of each moulding on the profile, as 9, 10, 11, 12, and draw *a b*; from all which points in the mouldings draw viſuals to *s*, which will ſeverally cut the aforeſaid perpendiculars at *q*, *p*, *n*, *m*, *r*. Draw then the line *m n*, *p q*, whic will be the diagonal lines of the internal miters. Now draw parallels from *p q*, which will cut the perpendiculars at 13, 14, 17. From 14, 17, draw viſuals to *s*, which will cut at 15, 16; and it is evident that by theſe the three miter lines will be correctly determined. From each angle of the mouldings on the profile draw lines to *s*, and afterwards obſerve how the profiles are cut by each projecting diagonal, to which make every perſpective miter agree. For inſtance, draw a line from *v*, the point where the diagonal cuts the upper ſquare of the ogee, till it cut the miter line at *t*; from *t* raiſe a perpendicular ſhewn by

the

the dotted line, which will form the ſquare on that miter, from which the ſame ſquare muſt be traced round the dado, as is evident from the figure. In the ſame manner muſt the upper moulding be managed; which, after what has been ſaid, it would be a dull and tedious repetition to go through a deſcription of it. And I am perſuaded, that if the learner cannot comprehend it from what has already been ſaid and done on the figure, he would fail of attaining it after all that I could ſay on it. It remains now to conſider the baſe, with a part of the ſhaft of the column: and this will admit but of very little deſcription, when we ſuppoſe the learner already acquainted with repreſenting ſquares and circles, of which the baſe is compoſed; and if he be not, he muſt turn back to theſe, for it is impoſſible to draw a figure to ſhew all theſe, without confounding the whole. The principal thing to be obſerved in this matter is, firſt, after having drawn *z*, the plinth on which the baſe reſts, on it a circle muſt be repreſented for the bottom of the torus, ſomewhat leſs than the plinth, determinable from the profile; after which the projection of the torus muſt be found, by drawing the lines *h*, *g*, *w*, to *s*, cutting a parallel from the plinth L at *i*, *k*, *b*. Take half *k l* and place it from *x* to *z*, and a line from *z* to *d*, cutting the viſual *x s*, will find the projection of the torus, as the dotted upright line ſhews. Upon this torus muſt be repreſented a ſquare, ſo much leſs as the projection of the torus; in this ſquare a circle muſt be repreſented to guide the top of the

torus,

torus, and having already drawn one for its bottom, by theſe it may be completed. Next find the height of the fillet above the torus, which is done by drawing viſuals from the points above *x*; and by a ſteady hand and good eye the fillet may eaſily be drawn, by following the upper part of the torus. Laſtly, to find the projection of the conge or hollow; take half *k l* and place it from *z* to *y*, and direct a line to *d*, as before, cutting at the ſecond upright dotted line; how the reſt is performed is only to repeat what was neceſſary in repreſenting the other parts of the baſe, and therefore it is needleſs to ſay more, except to obſerve the neceſſity of taking care in drawing the curve lines, ſo that the torus may ſeem to reſt eaſy on its plinth, and not appea ſtart ſuddenly up, as is commonly the caſe in ſuch repreſen ons, when they are drawn by perſons who only underſtand perſpective, but are deſtitute of taſte in drawing.

Example III. Fig. 31. Plate XXIII.

How to repreſent a Tuſcan Entablature and Capital parallel to the Picture.

In the preceding example, the pedeſtal, baſe, and part of the ſhaft, are all under the horizon, conſequently the returns of each moulding ſeem to riſe up; but in the example before us,

H d s L

Fig. 29.

Two flights of Stairs in perspective See explanation page. 297.

half the distance

H d L s

Fig. 30.

A Tuscan pedestal and abase in perspective See Explanation in Page 299.

To supply the defect of Fig 32 Plate. 5.

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us, every part is above the horizon, and therefore each returning member appears to deſcend. Hence this horizontal line is in a reverſe ſituation to the other, being under the object as the line H L, and that which we formerly ſtyled the ground line, whereon was laid each original meaſurement, is now at S P, properly termed a ſection of the picture, on which theſe muſt be placed. Therefore having drawn Y, the profile of the entablature, taken as before from Plate VIII. Lay on A B the full extent of the cornice, and from A B draw viſuals to *s*; divide A B at E, and draw another viſual to *s*. Conſider then how far the entablature is to be repreſented from the picture, which in this example is equal twice E F, becauſe we have only uſed half the full diſtance. Draw then a line from F to *d*, cutting at G; through G draw a parallel, cutting at I K, which will then be the front edge of the greateſt projecting part of the cornice. And ſince the line from F to *d* is in a direction only to half the diſtance, it will cut the viſual A D, tending to *s*, in the ſame point as it would be cut if a line from K was directed to a diſtance twice *s d*; therefore a parallel line from D to C will repreſent a ſquare equal to the whole projection of the cornice. It is neceſſary for the learner to be clear in this, otherwiſe he will not know what he is about, nor underſtand the ſucceeding directions. Having then found this ſquare, draw the diagonals K D, I C, which diagonals muſt neceſſarily give the

proper

proper direction to each miter at the top of the cornice. Take then, from Plate VIII. half the upper diameter of the column, and place it each way from E at M N. Draw from M N viſuals to *ſ*, which will cut the aforeſaid diagonals at 1, 2, and 3, determining the ſeat of the cornice, and the other mouldings. Let fall perpendiculars from the points 1, 2, 3. Proceed now to draw lines from each moulding in the profile to *ſ* the center; and alſo from Q draw one to the center. Produce the parallel from 1 to 4, cutting the line Q. From 4 let fall a perpendicular, then will the viſual line O from the bottom of the cornice be cut at U. From U draw a parallel, cutting the perpendiculars from 1, 2, at 6, 7; from 7 draw a viſual to the center *ſ*, cutting the perpendicular from 3 at 8. Draw the projecting diagonal O 9 of the profile, and ſtrictly obſerve how it cuts each moulding. Draw alſo U 10 of the internal miter. In like manner draw 6, 10, 7, 12, and 8, 13. Now from the internal miter, as at *e*, *a*, *b*, *c*, draw parallels, cutting the other projecting diagonals round the cornice, in the ſame proportion as that of the profile. Every other particular muſt be obvious from inſpection, after what has been ſaid already on the pedeſtal.

It now remains to find the repreſentations of the architrave and capital. To do this, take the projections *f*, *g*, *h*, from the profile, and place them from Q at *i*, *k*, *l*, and from theſe direct

lines

lines to *s*, cutting the miter line near 4, as ſpecified by the points. From each of theſe points let fall perpendiculars to their reſpective viſuals already drawn; that is, from the point neareſt 4 let fall a perpendicular to *m*, from the next point let fall one to *o*, and from the laſt point let fall one to *n*, which will find the internal miter. From each of theſe miters draw parallels at pleaſure, as ſhewn by the figure. Laſtly, theſe parallels muſt be cut, in order to determine the projection of each miter in the repreſentation, which is eaſily done, by the ſame method uſed in the internal miter: thus, from M N lay on each way *i*, *k*, *l*, the ſame as *i*, *k*, *l*, near Q, and direct viſual lines to each miter line at 1, 2, 3. From each of theſe points let fall perpendiculars as before to their reſpective parallels, and each miter will be found, as is evident from the figure. With reſpect to the circular mouldings in the capital, theſe muſt be drawn by firſt finding the ſquares in which they may be inſcribed, and then uſing that freedom of hand and good taſte, which are the beſt and only guides that can be uſed in theſe caſes. And here the learner ſhould be put in mind, that the example before us not only ſhews how to repreſent the Tuſcan entablature, but alſo how to draw broken mouldings parallel to the picture, or how to repreſent a cornice round the inſide of a room. For if the dotted lines drawn from the internal miter were made good and ſhaded, and if thoſe returning to the profile were alſo ſhaded, the effect would then be ſeen.

I ſhould have been glad to have aſſiſted the learner in the repreſentations of the other four orders, but he muſt be ſenſible that it would be impoſſible for me either to find room or time for ſuch an arduous taſk in a work like this, which calls for place and attention to ſo many different articles. It is my opinion, however, that if the learner thoroughly acquaint himſelf with the repreſentation of the Tuſcan order, he will not be at much loſs how to draw the other, except in the capitals of the three laſt orders when they are oblique to the picture. But theſe will rarely, if ever, be wanted by thoſe for whom this work is intended. However, if they ſhould, I will refer the reader to Mr. Malton's work, as the beſt I know of, for their aſſiſtance in this matter.

EXAMPLE IV. FIG. 32. Plate XXIII.

How to repreſent Arches parallel and perpendicular to the Picture.

FIRST, of arches parallel to the picture.

Let A, B, C, D, be an arched paſſage, whoſe entrance is parallel to the picture, in which caſe the arch is ſimilar to its original; that is, a perfect ſemicircle, as demonſtrated by Fig. 20. Plate XIX. and page 284. Therefore let the line 2, 4, drawn

parallel

parallel to the ground be the diameter, and E the center of the arch; ſweep the arch as in any other circle; draw the viſuals A *s*, B *s*, and make *d* the diſtance. Conſider next the ſize of the pier or pillar on which the arch is to reſt. Let A K be the thickneſs, and draw K *d* cutting at P. Draw P Q parallel to the ground, and raiſe a perpendicular from Q. From 2, 4 at the ſpring of the arch, and from E the center, draw lines to *s* the center of the picture; and the viſual line from 4 to *s* cutting the perpendicular from Q at 3, draw from 3 a line parallel to 2, 4, cutting the viſual E *s* at I; then will I be the center of the furtheſt ſemicircle, which completes the arch, by fixing the foot of the compaſſes in I, extending the other to 3, and ſweeping the arch 1, 3, as the figure ſhews.

EXAMPLE V. FIG. 32. Plate XXIII.

To repreſent Arches in a perpendicular Direction to the Picture.

LET the perpendicular line A 7 be the original height of the arch-way. Draw from 7 a line to the center *s*, and make 7, 8 equal to the ſemidiameter of the arch, and from 8 draw a line to *s*. Next conſider how far the arch is to be from the front of the picture, which is here equal A K. From K

draw a line to *d*, the diſtance, cutting at P; and from P raiſe a perpendicular, cutting at 10. Take 8, 7 equal to the ſemidiameter of the original arch, and repeat it from K to N, from N to S, from which draw lines to the diſtance, cutting the viſual A *s* in O Y. From theſe raiſe perpendiculars, cutting at 11 and *e*; then will *a* be the center of the arch. Draw then the diagonals *a* 11, *a* 10, and divide 9, 10, or 8, 7, into ſeven equal parts, and take two of theſe, as at 12; from which draw a line to *s*, cutting the diagonals, as the figure ſhews by the points. Through theſe points draw, by a ſteady hand, this ſide of the arch. For the other ſide of it proceed in the ſame manner, by drawing viſuals from 2, 13. Laſtly, draw *a c* parallel; alſo 10, 14, and 11, 15; then from *c* to 15 and to 14 draw diagonals agreeing with the other, and cut theſe as before, by a line from 16, by which the other ſide of the arch will be repreſented; that is, as much of it as ought to appear. The part which does not appear is denoted by the dotted curve. In the ſame manner proceed with the ſecond, or with as many more arches as may be wanted, by repeatedly laying on the ground line the original meaſurement at T V.

EXAMPLE

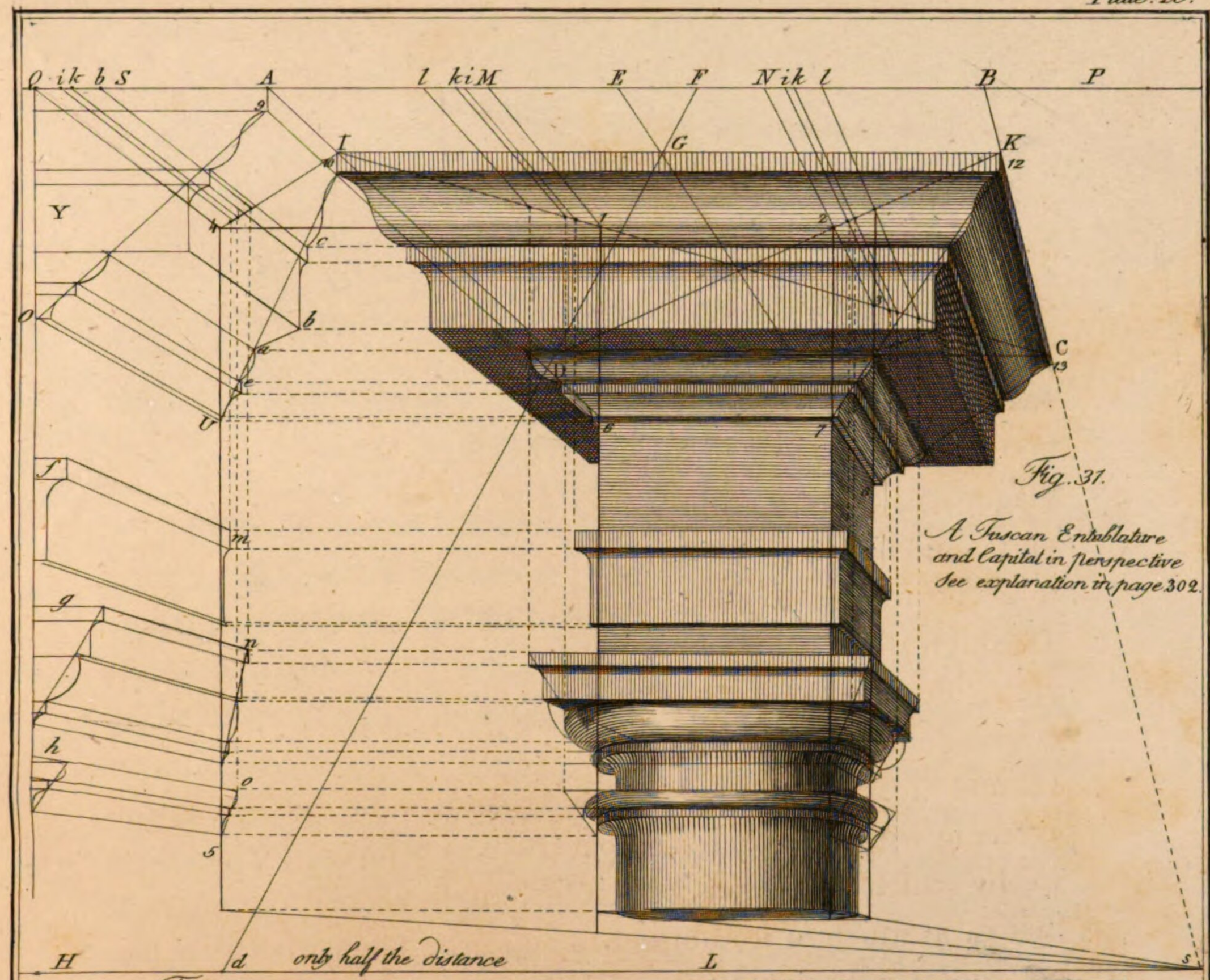
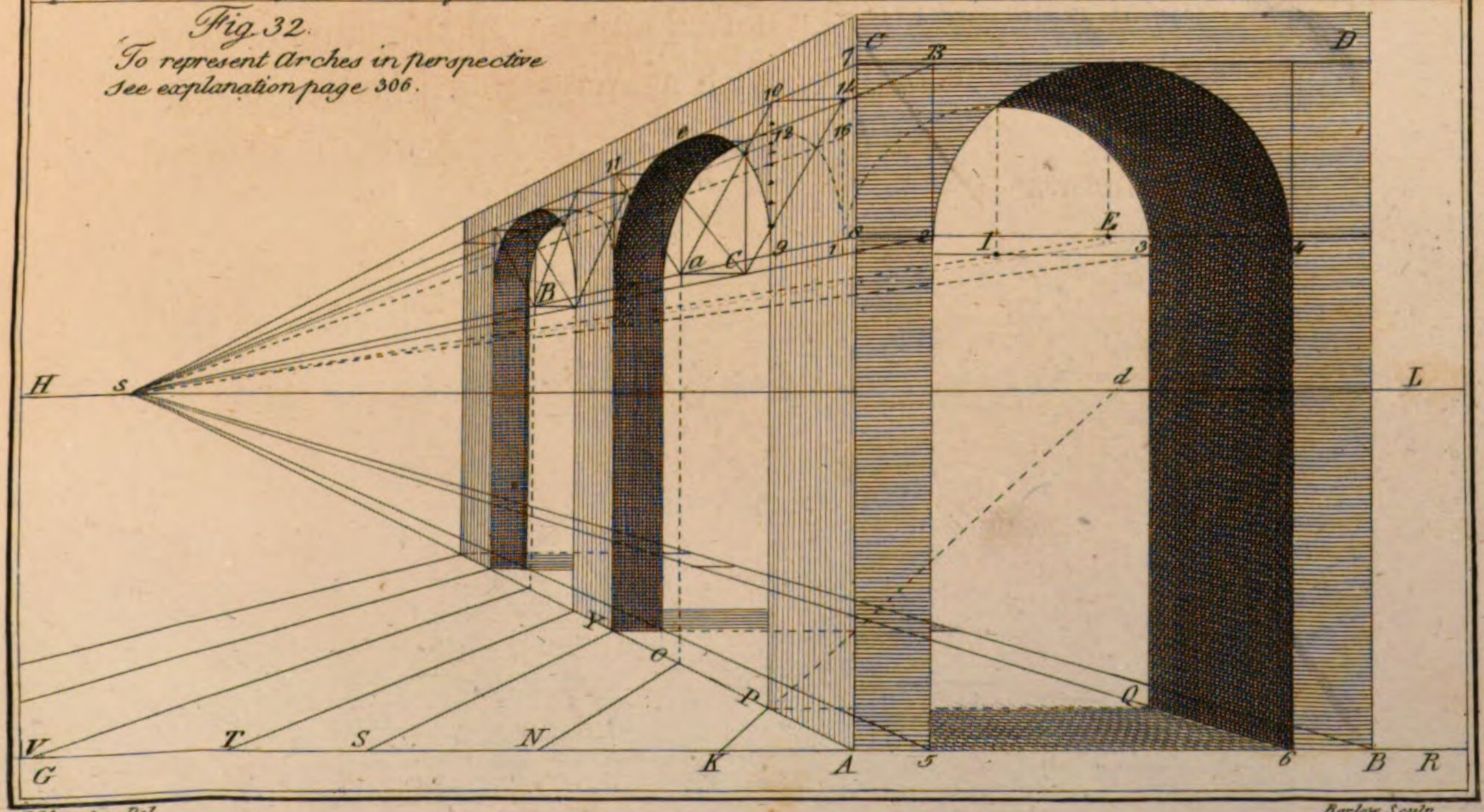


Fig. 31.

A Tuscan Entablature and Capital in perspective
See explanation in page 302.

Fig. 32.

To represent Arches in perspective
See explanation page 306.



T. Sheraton. Del.

Barlow. Sculp.

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EXAMPLE VI. FIG. 33. Plate XXIV.

How to repreſent a Houſe in Perſpective, having its Front parallel to the Picture.

LET H L be the horizon, and G R the ground line, *s* is the center, and *s d* the diſtance of the picture. Make A C the original length of the front, from which draw viſuals to *s*. Conſider next how far the houſe is removed back, which is here equal C 1. From 1 draw a line to *d*, cutting at 7; and from 7 draw a parallel to 8. Draw a plan of the roof 1, 2, 3, 4. And from *d* the diſtance, draw *d v* parallel to the ſide of the roof 1, 2; then will *v* be the vaniſhing point for that ſide of the roof. Take *s v* and place it below the horizon at V, perpendicular to *s*; then will V be the vaniſhing point of the other ſide of the roof 2, 3. From 8 and 7 raiſe perpendiculars at pleaſure, and make A F the original height of the front. From F draw a line to *s*, cutting at 9; draw a parallel from 9 to 10. For the windows and door, lay their original meaſurements on A F and A C, drawing viſuals to *s*, as the figure ſhews; and as the front is parallel to the picture, conſequently each object on it is ſimilar to their originals*, and therefore lines perpendicular to 8, 7,

* See pages 274 and 275.

and

and 9, 8, will form the ſides, tops, and bottoms of each window and door-way. From 9, 10 draw lines to *v*, the vaniſhing point of the roof; from 10 draw a line to *s*, the center. Take then 1, 3, the ſpan of the roof, and place it from F to B; and from B draw a line to *s*, cutting at 11; from 11 draw a line to V, below the horizon, cutting at 14; from 14 draw a parallel to 13, for the top of the roof; and from 13 draw a line to V, cutting the line 10 *s* at 15, forming the fartheſt ſide of the roof; draw a perpendicular from 15 to 6, which will complete the end of the houſe. Laſtly, to find the height of the chimney, draw a line from *s* through 14, cutting at E; and from E lay on the original height of the chimney to D; and from D draw a line to *s*, cutting a perpendicular from 14, which will give the height required.

Method ſecond.—The front of the houſe being drawn as has been deſcribed, to find the appearance of the roof and gable-end, draw the roof 1, 2, 3, as before; and from 4 and 3 draw lines to *d*, cutting at 5, 6; from 5, 6 raiſe perpendiculars at pleaſure; from 5 draw a parallel to O, cutting the viſual A *s* at O, for the center of the left gable-end; from O raiſe a perpendicular at pleaſure. Take then the perpendicular height of the roof, from 4 to 2, and place it from F to E; and from E draw a line to *s*, cutting the aforeſaid perpendicular at 14, which will give both

the

the pitch and height of the roof. From 14 draw a parallel to 13, cutting the other perpendicular correſpondent with 14. Laſtly, from 9 draw a line to 14, and from 10 draw a line to 13, and from 13 to 15, which will determine the appearance of the roof, as before.

Example VII. Fig. 34. Plate XXIV.

To find the Repreſentation of a Houſe whoſe Gable-end is parallel to the Picture.

In this caſe the front that was before parallel to the picture is now turned perpendicular to it. The gable is therefore parallel to the picture, and is nothing more than a geometrical elevation, found by laying on the heights on *a b*, and the widths on *a f*, and drawing lines from theſe to *s*, the center; *m f* is the diſtance of the houſe from the picture; and a line from *m* to *d*, cutting at *n*, finds the repreſentation of that diſtance. The other lines to the left of *m*, all tend to *d* alſo, by which the windows and doors, &c. are found; *m q* is equal to the original length of the front, a line therefore from *q* to *d* determines its apparent length on the picture. For the pitch of the roof, draw *e s*, cutting at *p*; from which raiſe a perpendicular; draw another perpendicular from *w*, the center of the

other

other gable-end; alſo draw the viſuals *k s*, *l s*, for the roof; which viſuals will cut perpendiculars at *h* and *i*, anſwering to the points *l k*, by which the roof is formed. For the reſt, the figure itſelf is ſufficient, by obſerving that *u t* is the perpendicular height of the roof, and *t b* of the chimney.

EXAMPLE VIII. FIG. 35. Plate XXIV.

How to repreſent a Chair, having its Front parallel to the Picture.

AFTER having made a ſcale of feet and inches to proportion each part of the chair by, draw A, the profile of the back and ſide rail; and draw B on the right, according to the bevel of the ſeat; and obſerve, to diſtinguiſh the lines of each chair, one is marked with ſmall letters, and the other with numerals.

Let H L be the horizon proportioned by the ſcale, about five feet high from G R the ground line. Make *a b* equal to the length of the front; from which draw lines to *s*, the center, which, in general, ought to be perpendicular over the middle of the chair, becauſe it affords the moſt eaſy and natural view of its back. Next, from *q*, the width of the ſeat, draw a line to the diſtance, here out of the plate, cutting the viſual *a s* at *c*;

from *c* draw a parallel to *e* at pleaſure. Take C D, the bevel of the ſeat, and place it from *a* to *d*; and from *d* draw a line to *s*, cutting *c e* at *y*, which gives the bevel of the ſeat. From *a* draw a line through *y*, cutting the horizon at V, which will be the vaniſhing point to every line originally parallel to *a y*, the ſide rail; take *s* V and place the ſame ſpace to *v*, which will be the vaniſhing point to the other ſide of the chair; therefore from *b* draw a line to *v*, cutting at *e*, which forms the ſeat. For the thickneſs of the back rail, draw a line from *p* to the diſtance, as the figure ſhews. For the height of the back, raiſe a perpendicular *a g*, and draw a parallel from *r* to *g*; draw alſo a perpendicular from *y*, and a line from *g* to V will cut it at *f*, determining the height of the back. For the bottom of the back foot, draw a line from *u* to the diſtance, cutting a perpendicular from *c* at *w*. From *w* draw a parallel, and from *z* draw a line to the vaniſhing point V, cutting at *x*, which will determine the place of the back foot*. How every other part is done, muſt be evident from inſpecting the figure.

* The reader will perceive that the line from *z* to *x* is not accurately drawn, for the engraver did not follow his copy, otherwiſe the line would have touched the bottom of the back foot tending to V, which the learner may prove, by drawing a line from *z* to V. This inſtance may ſerve to ſhew the trouble there is with engravers, who in general are totally ignorant of perſpective.

EXAMPLE IX. FIG. 36. Plate XXIV.

How to repreſent a Chair having its Front perpendicular to the Picture.

IN this example the ſame ground line, horizon, center, and diſtance, is uſed as in the preceding; therefore let the ſpace 7, 1, be equal to the length of the chair front. From 7 draw a line to *s*, and from 1 draw a line to the diſtance, cutting at 16. Make 7, 9 equal to the length of the ſide rail, and from 9 draw a line to *s*; make 9, 10 the thickneſs of the back foot, and from 10 draw a line to *s*, as before. Draw a parallel line for the depth of the ſide rail, and from 8 draw a line to *s*. Next conſider how much the back foot ſweeps off from the perpendicular, which is equal to the ſpace 12, 13, or 2, 22; draw viſuals from each of theſe points, as the example directs. To find the bevel of the ſides, take C D and place it from 7 to 5, and from 1 to 3; from which draw lines to the diſtance, cutting at 11 and 17; from 11 and 17 draw parallels cutting the viſual 9 *s* at 20 and 18; from 7 draw a line to 20, and from 16 draw one to 18, which will finiſh the outline of the ſeat. Laſtly, from 18 and 20 let fall perpendiculars, cutting at 24, 25; from which draw parallels to the viſual 13 *s*, which gives the bottom of

Houses in Perspective. see explanation page 309

Fig. 33.

Fig. 34.

Chairs, in Perspective. see page 312

Fig. 35.

Fig 36

1 Foot

T. Sheraton del. Published by. T. Sheraton. Aug. 1. 1792. G Terry Sc.

each back foot; and for every other particular, a little reflection and obſervation will be ſufficient.

EXAMPLE X. FIG. 37. Plate XXV.

How to repreſent a round Table in Perſpective, having two of its Claws in front parallel to the Picture.

DRAW a profile of the pillar and claw, as at A. Take *a b*, the ſpring of the claw, from the center of the pillar, and with it deſcribe a circle 1, 2, 3; divide the circle into three equal parts, ſo as to ſuit the intended poſition of the claws, as 1, 2, 3; draw from theſe perpendicular lines to *i*, *e*, *f*. Repreſent a ſquare 4, 5, 6, 7, equal to the diameter of the top; draw the diagonals and diameters of the ſquare, and from *i f* draw viſuals to *s*; from C, the center, draw a perpendicular for the pillar; and having determined the height of the table at B D, from B D repreſent a circle for the top, as has been taught in page 289, ſee Fig. 23. Next find the place of the claws; for which make *f e* equal *f* 2, and from *e* draw a line to the diſtance *d*, cutting at *g*; from *g* draw a parallel to *h*, for the other claw. To find the place of the back claw; extend the compaſſes from *e* to 3, and make 4 *c* equal to it; from *c* draw a line to the diſtance, cutting at *m*; and from *m* draw a parallel to *i*, which will be the place

of the claw. For the different parts of the pillar, draw from the profile lines to the diſtance, cutting the perpendicular C F, as the figure ſhews. It now remains for every part to be finiſhed by a good hand and eye accompanied with judgment, as no other rules can be of any ſervice in caſes of this ſort.

EXAMPLE XI. FIG. 38. Plate XXV.

How to repreſent an octagon Table having one of its Claws in Front perpendicular to the Picture.

DRAW the profile of the pillar and claw, as at B; and, as in the other example, take the ſpring of the foot or claw from the center of the pillar, and with it deſcribe a circle, and mark out the place of the claws at 1, 2, 3. Draw 1, 2, 3 up to the ground line, and produce 1 up to *u*, for the height of the table. Repreſent a ſquare both at top and bottom, and draw the diagonals, finding the center for the pillar. Draw now the dotted lines from the profile to *k u* the perpendicular, and where they cut draw lines to *s*, the center of the picture, cutting the center of the pillar for each reſpective moulding. Next find the ſituation of the claws; having drawn lines from *k*, *b*, *a*, to *s*, make *b b* equal *b i*; and from *b* draw a line to the diſtance, cutting at *g*, which will be the place for the firſt claw. Make *a c* equal *a* 3, and from *c* draw a line to *d*, as before, cutting at *b*; from *b*

draw

draw a parallel to *e*, then will *b e* be the place of the two other claws. From 5 and 4, produced from 7, the height of the toe, draw lines to *s*; and from *e* and *b* raiſe perpendiculars cutting theſe, which will be the height of the toes of the back claws. Laſtly, we here ſuppoſe the top to be an irregular octagon, wherefore let *m n* be equal to four of its ſides; draw from *n m* lines to *s*, from *n* draw a line to *d*, cutting at *o*; from *o* draw a parallel to *t*; finding the oppoſite angle, draw *m t*; and from the diſtance draw a line through *w*, cutting at *r*; from *r* draw a parallel to *p*; and draw *p q*, which will finiſh the octagon for the top.

EXAMPLE XII. FIG. 39. Plate XXV.

To put a Commode Table in Perſpective, having its Front parallel to the Picture.

OBSERVE, the ground line for the tables is here uſed as the horizon for the commode.

Make *s d* half the diſtance, for want of room on the plate, and make G R the ground line. Draw then the plan P of the front, according to the intended ſcale. And, in cutting of each viſual line, uſe one half of a foot inſtead of a whole one; becauſe only half the whole diſtance is uſed. Therefore, having drawn

drawn the viſuals 3 *s*, B *s*, draw a line from 1 foot on the ſcale line to *d* the diſtance, cutting at *g*; then will 3 *g* repreſent a line two feet long, equal to the breadth of the commode. From *g* raiſe a perpendicular, cutting at *m*, finding the apparent width of the top; draw 5, 10 parallel and equal to the height of the foot and bottom of the commode; draw parallel lines, alſo, for the partition below and above the drawer, and for the top, as ſhewn by the figure. Proceed now to find the place of the feet and the ſweep of the front: for the feet take half 3, 4, and from 3 place it to 6; from which draw a line to *d*, cutting at 2; from 2 draw a parallel cutting B *s*, for the other foot. Find now two points by which to direct the ſweep of the front thus: draw perpendicular lines from the plan at 9, 12, and from 13, *i*, *k*, where they cut, draw lines to *s*; then take half 8, 9 and place it from *k* to *i*; and from *i* draw a line to *d*, cutting at *p*, finding a point for the curve; from *p* draw a parallel to *t*, finding the oppoſite point, which will be ſufficient for the whole. Laſtly, for the receſs draw viſuals from *r f*, and, ſuppoſing the receſs to be a foot deep from front, make *e f* equal half a foot on the ſcale; draw from *e* a line to *d*, cutting at *o*; and from *o* draw a parallel to the oppoſite viſual. Every other thing may be learned by obſervation, without going through a minute detail of every particular, which would become an exceeding dry taſk indeed.

EXAMPLE

Tables in perspective see explanation page 315.

Fig. 37

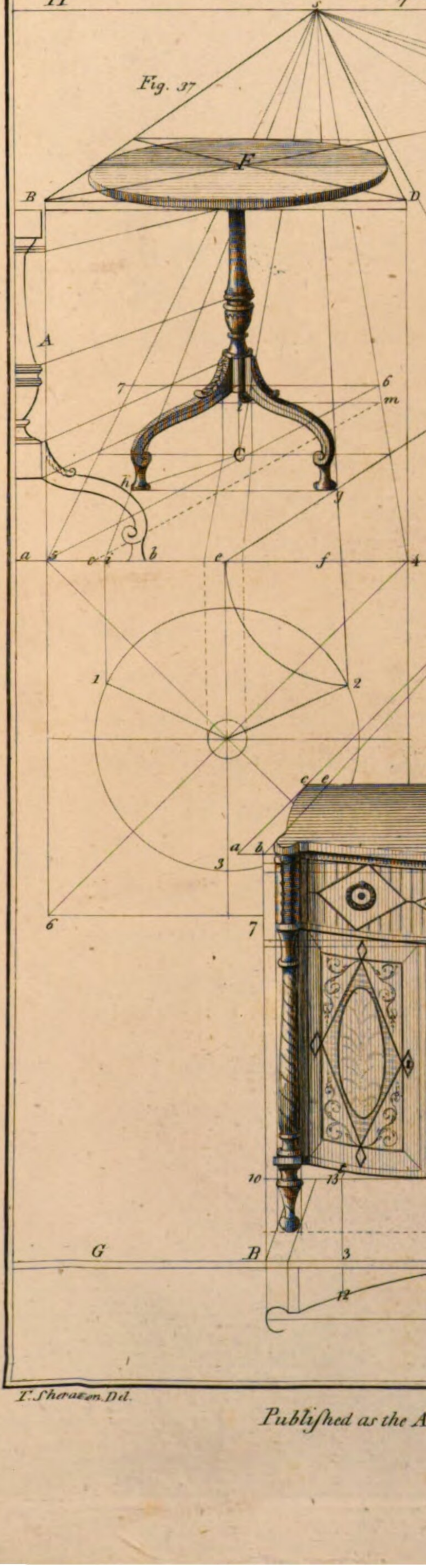


Fig. 38

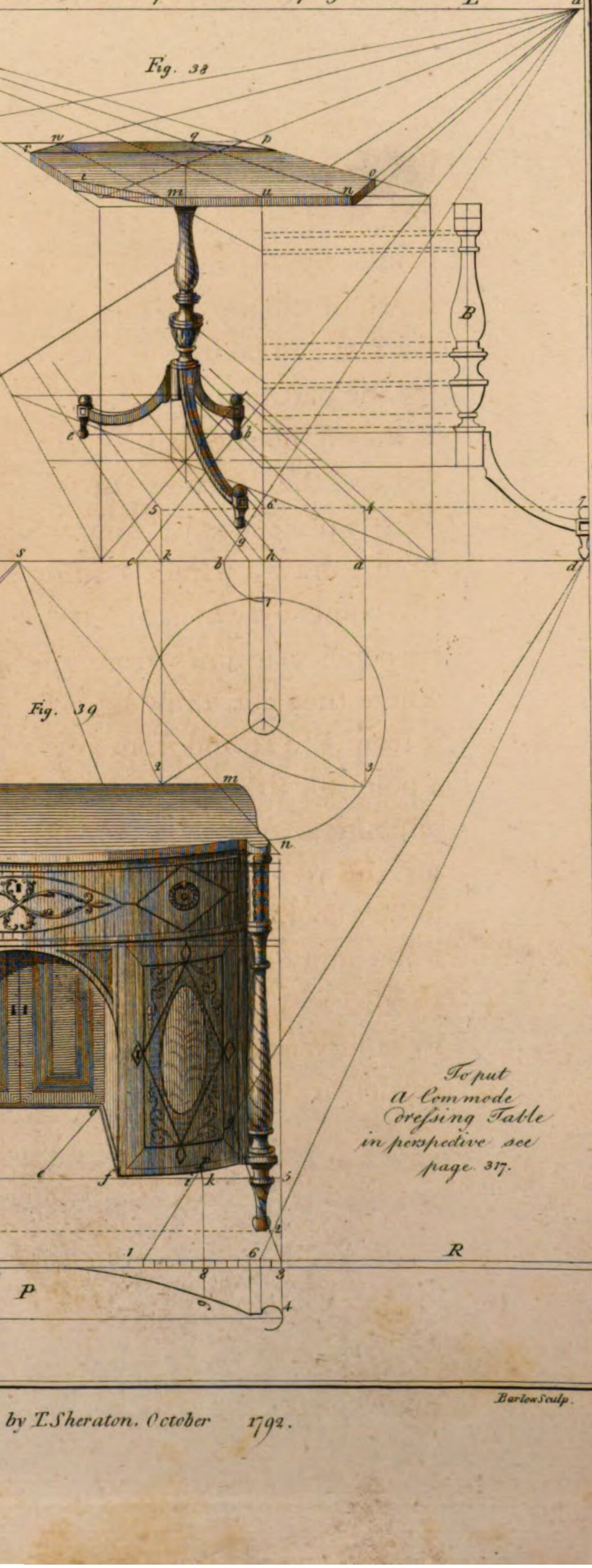
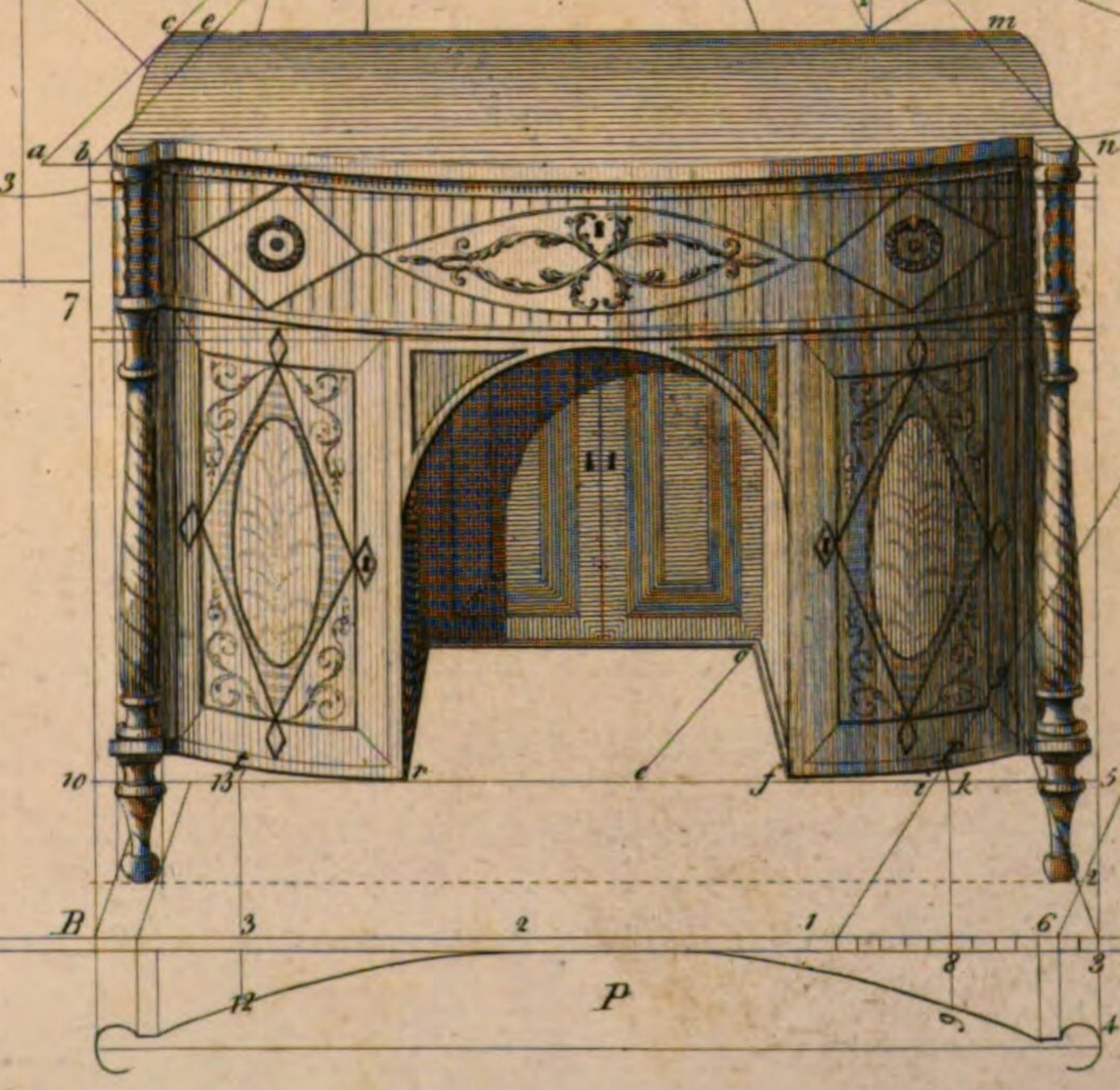


Fig. 39



To put a Commode dreſsing Table in perspective see page 317.

T. Sheraton. Del.

Barlow Sculp.

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EXAMPLE XIII. Fig. 40. Plate XXVI.

How to repreſent a Chair obliquely ſituated to the Picture.

IN the two former examples of chairs in perſpective, the firſt of theſe had its front parallel to the picture, which is the moſt uſual way of repreſenting a chair when it is wanted to be viewed as a pattern; for the back being parallel alſo, it gives the moſt natural and diſtinct view of the baniſter and all its parts. The ſecond is put with its front perpendicular to the picture, which is a poſition wanted in the repreſentation of internal views of rooms or paſſages: and this third example being put oblique, is conſidered by painters moſt pictureſque or ſuitable for a picture, in which caſe the pattern of the chair is not much regarded, only its unformal ſituation ſuiting to the ſubject and circumſtances of the deſign. In this example I ſhall therefore conſider myſelf as offering ſome aſſiſtance to the painter, as well as in a few other inſtances in this book.

Obſerve, that the vaniſhing points *v* V, and meaſuring points *m* M, of this example, are all found by laying the diſtance downwards to D, for want of room on the plate, and which needs not here be explained, after what has been done

in

in problem VI. page 236, as it makes no difference whether the diſtance be above or below the horizon. Therefore proceed in conſidering G R the ground line, drawn parallel to the horizon H L; on G R make a ſcale of inches to proportion every part by. Make *a f* equal to the original length of the front, which in parlour chairs is generally 21 or 22 inches; and let *a g* be equal to the width of the ſeat from the inſide of the back to the front, commonly 16 inches. As *a* is conſidered the neareſt angle to the picture, from *a* raiſe a perpendicular at pleaſure, on which the original heights of each part muſt be laid, as from *a* to *m*, for the height of the ſeat rail, about 16 inches without the ſtuffing. From *a* and *w* draw viſuals tending to V and *v*. From *f c* draw lines to *m*, cutting at *x y*; from *b* do the ſame, cutting at 3; from which points raiſe perpendiculars for each foot. Next, from *g* draw a line to M, cutting at *k*; from which raiſe a perpendicular to *o*; from *o* draw a line to V; and from 4, the inſide of the front foot, whoſe thickneſs is ſuppoſed equal to the bevel of the ſide rail, draw a line to *v*, cutting at *p*; then from *w*, the outſide of the foot, draw a line to *p*, produced till it cut the horizon at *o*, which will be the vaniſhing point to every line originally parallel to the ſide *w p*. From *v* extend the compaſſes to *o*, which lay on to O, and O will be the vaniſhing point to all lines parallel to the other ſide *t* 5. Therefore, from *t* draw a line to O, which will cut at 5, completing the form of the ſeat. On the perpendicular line from *w*,

lay

lay on 21 inches for the height of the back, and direct a line to *o*, and through *p* draw a perpendicular at pleasure for the joint of the side rail. Next consider how much the back foot pitches, which in this example is equal *h g*, and *h i* is for the thickness of the toe. From these draw lines to M, cutting at *k*, *l*, *n*; and from *k*, *l*, *n*, draw lines to V, which will cut the visual *b v* in the place for the toe at 8, 6; from 6 raise a perpendicular cutting at 7, and from 7 direct a line to V, for the top rail; and how the rest is performed must be obvious from what has already been said and done.

EXAMPLE XIV. FIG. 41. Plate XXVI.

To put a Cylinder Desk and Book-case in Perspective, having its Front oblique to the Picture.

DRAW first an elevation of the cornice and pediment, and proportion the pediment according to Fig. 36, Plate V. by dividing half the length of the cornice into nine equal parts, of which take four for the pitch. Take one of these parts for the height of the pedestal, and the remaining three for the vase. Draw lines up to the ground line at *q*, *r*, F, *p*, *f*, and the vanishing points having been already found, draw from *r* lines tending to each; from *r*, the nearest angle of the book-case, raise a

 perpendicular

perpendicular at pleaſure, on which the ſeveral heights muſt be laid. From *r* to A lay on the depth of the lower part, and direct a line to M, cutting at U, and make A B the depth of the book-caſe, and draw a line as before, cutting at X, from which raiſe a perpendicular. In the ſame manner draw lines from F *p*, tending to *m*, and cutting at 3, 12, for the length and center of the book-caſe. The ſeveral original heights for the deſk part, doors, and cornice, muſt now be placed on the perpendicular, from which lines muſt be drawn to each vaniſhing point. And here we muſt obſerve, that as the neareſt angle of the book-caſe comes forward to the picture*, conſequently the ſlider is on this ſide of it. To project the ſlider in this caſe, a vaniſhing point muſt be found, from which, if a line be directed it will paſs through the diagonal of any ſquare. Thus: on D, the diſtance, ſweep the arch S, and biſect it at S, and through S direct a line to the horizon, cutting at *d* on the ſmall drawers; lay from *r* to *g* a ſpace equal to the projection of the ſlider; and from *g* direct a line to *m*, cutting at *i*; from *i* raiſe a perpendicular to *y*; and from *d*, the aforeſaid vaniſhing point, draw a line through *y* at pleaſure; and from *v* draw a viſual for the end of the ſlider, cutting at *n*; from *n* draw a line to V, and from *v* draw one through 10, for the other end of the ſlider. The opening of the door is next to be conſidered. It is evident

* When any object is repreſented to touch the ground-line, that part which touches it is ſaid to be in the picture.

that

that a door turning on its hinges muſt deſcribe a ſemicircle, and therefore if a ſemi is repreſented, whoſe radius is equal to the breadth of the door, its circumference will determine any opening that can be propoſed.

To deſcribe the ſemicircle proceed thus.—From the vaniſhpoint *v* draw a line through *z*, the center of the book-caſe, and produce it at pleaſure; then from *d*, the vaniſhing point of any diagonal, draw a line through 12, cutting at C; from C draw a line to V; and from *v* draw a line through 12, cutting at K; and from K draw another diagonal to *d*, cutting at *w*; from *v* draw a line through *w*, cutting at E, and produced to Q, cutting a parallel from C; from 12 to E draw a diagonal, and if the door is intended to be opened 45 degrees more than ſquare, produce this diagonal, as ſhewn by the dotted line, till it cut the horizon, and its interſection with it will be the vaniſhing point for the top and bottom of the door. Divide C Q into ſeven equal parts, and from one of which at 7 direct a line to *m*, cutting at 13; and from 13 draw a viſual to *v*, cutting at 1; from 1 draw a viſual to V, cutting the other diagonal at 2; from 2 raiſe a perpendicular for the apparent breadth of the door in this poſition; and from the laſt mentioned vaniſhing point found by the dotted line, draw lines for the top and bottom of the door, by which it may be completed. For the ends of the cylinder we need not ſay any thing, as this is the ſame as in pro-

blem XXII. therefore we ſhall proceed with the cornice and pediment.

Set off the projection *q r* of the cornice at 6, 5, on a parallel line drawn at the full height of the book-caſe, and draw lines to *v*, and the line 5 will cut the perpendicular raiſed from X, and the line 6 will cut a perpendicular at 8, ſuppoſed to be raiſed from *t*, the miter point of the cornice, which is found by drawing a line from *d*, the vaniſhing point of the diagonal to X, cutting at *t*; from *t* direct a line to V, cutting at *a*; and from *a* raiſe a perpendicular, which will cut a line drawn from 8 to V, at the other miter point; every other part of the cornice muſt be finiſhed by the reader's judgment, governed by theſe principles, as it would be impoſſible to apply every rule in ſuch ſmall examples.

Laſtly, for the pitch of the pediment, a vaniſhing point muſt be found, according to the principles in Problem IX. Plate XVI. by drawing a line from *m* parallel to the pitch line at the elevation P, produced to V P, cutting a perpendicular from V; from 8 draw a line to V P, cutting a perpendicular in the center of the front edge of its cornice; from which draw the other ſide of the pediment, which, if produced, would cut a point as much below the horizon as V P is above it. Theſe pitch lines being found, the ſcroll pediment may be drawn by hand with

ſufficient accuracy; but if the pediment be a ſtraight pitch, then the lines for each moulding muſt tend to V P, and to a point as much below the horizon. And I would here obſerve, that in drawing after theſe examples, it is not intended that the diſtances made uſe of in them ſhould be a precedent to the learner. Theſe are choſen to ſuit the plate; but the learner having ſufficient room on his drawing-board, muſt chooſe his diſtance to give the moſt natural and pleaſing effect to his drawing, by the rules already laid down. See page 275.

In theſe examples almoſt every difficult part of perſpective is introduced, and it is preſumed that, after the learner has made himſelf fully maſter of them, nothing will occur in practice that can give him much trouble, eſpecially if he be properly acquainted with the ſhort theory that has been given. However I am fully perſuaded, that no cabinet-maker or upholſterer will ever want to practiſe more; and, if I am not miſtaken, there are but very few painters who are at the trouble of practiſing ſo much. But if the reader's profeſſion or neceſſities ſhould require him to extend his ſkill in this art further than what has been advanced in this treatiſe, I will freely refer him to Mr. Malton's complete Treatiſe, from which, it is here gratefully acknowledged, I have received conſiderable aſſiſtance.

SECTION

SECTION VI.

Containing a ſhort View of the Nature and Principles of Shadows, cauſed by the Sun coming in different Directions to the Picture; together with ſome Remarks on the Effect of Light and Shade in general.

WHAT has hitherto been done in the foregoing ſections is termed by artiſts linear perſpective, which propoſes rules for drawing the outlines of objects in every ſituation, proportioned one to another according to their magnitude and diſtance from the picture; but the ſubject of the preſent ſection is to propoſe rules for giving effect to theſe outlines, by the different circumſtances of light and ſhade. The mere outlines of a drawing is but as a ſkeleton without fleſh or life, but by the addition of proper light and ſhadow, we may almoſt behold nature in a picture: and that which before appeared flat and inſipid, now obtains the force and effect of the objects themſelves.

The doctrine of light and ſhadow may be conſidered under three heads. As,

Firſt, when the force of the ſun's rays fall on objects, and thereby produce a ſhadow ſtrongly defined.

Secondly,

Secondly, When the ſun is not ſuppoſed to ſhine, and the ſhadow is only produced by light ſimply conſidered, or by reflection.

Thirdly, When the light or ſhade of one object is proportioned with that of another at a greater diſtance in the ſame picture. This is termed the aerial part of perſpective, or the diminution of tints according to the diſtance of objects.

The firſt of theſe heads is, however, that which principally concerns us, it being reducible to ſtrict rules; the ſecond follows of courſe; and the laſt can only be learned by obſervation and practice.

In conſidering the ſhadows cauſed by the ſun's rays we may obſerve the following diſtinctions.

Firſt, When the ſun's rays are in the plane of the picture, or, which is the ſame thing, when they are conſidered parallel to it.

Secondly, When the rays come from behind the picture. And,

Thirdly, When they have their direction from the front of the picture.

Case I. Fig. 42. Plate XXVI.

To project the Shadows of Objects in various Positions when the Sun's Rays are parallel to the Picture.

The ſun, which is the great ſource of light, being at an immenſe diſtance from the earth, the rays of light iſſuing from it in right-lined directions, are conſidered as parallel to each other. The truth of this is proved by the parallel ſhadows which it always produces on a plane from objects which are parallel to each other and of equal thickneſs.

When, therefore, the rays are conſidered as parallel to the picture, the ſhadows of all objects are found by parallel lines paſſing by the angles of each object, and in ſuch a degree of inclination as the ſun is ſuppoſed to be in, either to the right or left of the center of the picture. Theſe lines, repreſenting the ſun's rays, being cut by lines from the baſes of each object drawn parallel to the ground-line, find every ſhadow in this caſe.

The learner will recollect, that in ſtating the theory of lines parallel to the picture in page 215, it is there ſaid, " Lines " which are parallel to the picture can have no vaniſhing line

or

" or point in it, becauſe if infinitely produced would never " cut it." The ſame holds good in the theory of ſhadows when the ſun's rays are parallel to the picture; for then they cannot cut it, and conſequently a vaniſhing point is not wanted in this caſe.

Hence the ſhadows of all lines perpendicular to the ground are drawn parallel to the ground line; and as, in perſpective, all lines perpendicular to the picture vaniſh into its center, ſo likewiſe the ſhadows of every ſuch line will tend to it. Therefore,

EXAMPLE I. Fig. 42.

SUPPOSE A to be the repreſentation of a wall perpendicular to the ground and to the picture, R R is a ray from the ſun inclining to the left in an angle of forty-five degrees, therefore the ſhadow 2, 3 of the perpendicular line 1, 2 is equal in length to the line itſelf. Draw the other ray *r r* parallel to R R, and the ſhadow *r o* will be equal to the height of the wall *o r*. The line 1 *r* is originally perpendicular to the picture, and vaniſhes in *s*, the center; ſo is its ſhadow 3 *r*, which likewiſe tends to it.

EXAMPLE II. Fig. 42.

SUPPOSE EB an object any where on the ground, whoſe ſides EB are oblique to the picture. Draw through each angle a ray *r r* parallel with R R the given one, and draw lines from the foot of each perpendicular, as 4, 6, parallel to the ground line, and their ſections with each other will form points for the outline of the ſhadow. Laſtly, from the point 5 draw a line to 7, and from 7 draw one to 8, and filling it up, the ſhadow will be completed.

Obſerve, the line 4, 9, and its parallels, are not perpendicular to the picture; therefore its ſhadow line 5 7 does not tend to *s* the center, but to the ſame vaniſhing point neceſſary for drawing the ſide B. In the ſame manner the ſhadow line 7 8 vaniſhes to the point requiſite for drawing the ſide E.

EXAMPLE III. Fig. 42.

LET D be an object having the ſide D inclined to the horizon, and the other ſides oblique to the picture. Draw a ray through *b*, and through *f* parallel to the given ray R R; from *g* the foot of *b*, and from *d* the foot of *f*, draw lines parallel to the

ground

ground line, which will interſect the rays at *a* and *c*. To complete the ſhadow, draw a line from the extremity of the inclined plane to *a*, and from *a* to *c*.

EXAMPLE IV. Fig. 42.

LET F be the ſtump of a column reſting on one end, whoſe ſhadow is required. Find the diameter of the column each way, both at top and bottom, as the figure ſhews; and through the extremities of theſe diameters draw parallel rays as before. Laſtly, from the foot of each perpendicular falling from the center and diameter, draw lines parallel to the ground line, cutting the rays at *v*, *w*, *x*; draw a curve to paſs through theſe three points, and the ſhadow will be projected.

Thus it is evident how eaſy a matter it is to project the ſhadow of any kind of object when the rays are parallel to the picture, and when the ſhadow is to fall on the ground plane, as in the foregoing examples.

It is, however, ſometimes neceſſary to project ſhadows falling on other objects contiguous to thoſe whoſe ſhadows are required. Therefore,

EXAMPLE I. Fig. 42.

SUPPOSE the object D ſtanding in the way of the ſhadow of A, a plane of rays paſſing by the end 1, 2 of the wall, will make a ſection of D at *t*, *i*, 3; which is found by drawing the line from 2 through to 3, and from 3, where it cuts the ray R R, raiſe a perpendicular to *i*, and from *i* draw a line to *t*, which will determine how far the ſhadow comes in front. Laſtly, the baſe line *t d*, of the object D, cuts a line from 3 at *e*; therefore, from *e* raiſe a perpendicular correſponding with 3 *i*, and from *i* draw a line to the aforeſaid perpendicular, and the ſhadow, ſo far as it affects the inclined plane D, will be found.

EXAMPLE II. Fig. 42.

SUPPOSE the object C near ſome inclined plane G, whoſe ſhadow falls upon it. To find the ſhadow, draw a line *h* to G, parallel to the ground line, at pleaſure; draw then a ray, as before, cutting at G, where the ſhadow would have terminated if the inclined plane had not been there; draw *m l* parallel to *n o*, cutting the ray at *p*; do the ſame at the other end, and the ſhadow will be completed.

Before I enter upon the other caſes of ſhadows, I would here remark, that this which has now been exemplified is, in my opinion, the moſt uſeful, as well as moſt eaſily practiſed. Particularly it is the moſt uſeful to the cabinet-maker and upholſterer, who only want it for ſhading different pieces of furniture; becauſe the ſhadows thus projected will be to the right or left of the piece, according as the light is ſuppoſed to come in; but in the two following caſes of the ſun's rays, the ſhadows will be projected either behind, or on the front of the piece of furniture, which ſituations of ſhadow are liable to the following objections.

Firſt, if the rays come from behind the picture, the front of the piece will be all in ſhadow, and conſequently the effect of diſtinctneſs of parts, which is always expected in furniture, will be deſtroyed.

Secondly, if the rays come on the front, then the ſhadow will be behind the piece, and therefore little or none of it will be ſeen, unleſs the point of light be taken very low, which is not very agreeable. Beſides, the light coming thus ſtrong on the piece, leaves a glare on the front that does not produce a pleaſing effect in furniture, nor ſufficiently diſtinguiſhes the front from the white ground of paper on which it is generally drawn.

Painters, indeed, are ſaid to make this laſt-mentioned poſition of light to the picture their choice, becauſe, I ſuppoſe, it clears their picture from the appearance of long black ſhadows, which would frequently look too harſh, and introduce confuſion, as is the caſe when the light comes in from behind. Yet as every caſe of ſhadowing may be neceſſary at times, though not out of choice, I ſhall therefore proceed to the ſecond caſe propoſed.

Case II. Fig. 43. Plate XXVI.

To project the Shadows of Objects when the Rays come in a Direction from behind the Picture.

When a ray of light comes in a direction not parallel to the picture, it will neceſſarily cut it in ſome point in the horizontal line, or vaniſhing line of the ground plane; for the ſun being at an immenſe diſtance, and the plane of the horizon being conſidered as infinitely extended, we may ſuppoſe a perpendicular let fall from the place of the ſun will touch ſomewhere on the horizon. And hence, the point where it touches the horizon is the vaniſhing point of the ſhadows, and conſequently a line drawn through the ſaid point perpendicular to the horizon will be the vaniſhing line of the ſun's rays; and any where on this line, if a point be fixed according to the ſuppoſed

altitude of the ſun, it will be the vaniſhing point of thoſe rays.

Thus:—in Fig. 43, the center and diſtance of the picture remaining the ſame as when uſed for drawing the cube, let it be required to find its ſhadow when the ſun's inclination to the left is thirty-two degrees, and when its altitude is forty-five. From *d*, the diſtance, draw the line *d h*, inclining from the perpendicular *s d* in an angle of thirty-two degrees; and through *h* draw S S perpendicular to the horizon; then will S S be the vaniſhing line for the ſun's rays. Make *h* M equal *h d*, and from M draw M S, making an angle with the horizon equal to forty-five degrees; then will S above the horizon be the vaniſhing point of the rays when the ſun comes from behind the picture, and S below it will ſupply its place when the rays come on the front. From the vaniſhing point *h* of the ſhadow draw lines through the angles 1, 3, 8, of the cube; and from S draw lines through its upper angles 2, 4, 9, interſecting the lines drawn from *h* in the points 5, 6, 10; from the point 5 draw a line to 6, and from 6 a line to 10, which completes the ſhadow.

Obſervations on the Theory of the above Figure.

THE rays S 6 and S 10, forming a triangle, may be conſidered as a plane of rays paſſing by the angle 4, 9 of the cube,

and

and being ſtopped on the ground plane at 6, 10, occaſions a ſhadow up to the cube, which ſhadow will vaniſh in the line 6, 10, to V; becauſe the angle or line 4, 9, which projected it, was drawn to, and vaniſhes in V; conſequently a line from V to S, the ſuppoſed place of the ſun, will be the vaniſhing line of the ſaid plane of rays. The ſhadow on the other ſide is compoſed of two lines, becauſe it is projected by two lines in different poſitions to each other. Thus the line 2, 4, originally parallel to the horizon and to the ground, projects the ſhadow line 5, 6 by the plane of rays 5, S, 6; which ſhadow line 5, 6 will vaniſh in V, becauſe the angle or line 2, 4 vaniſhes there. The ſhadow line 5, 1 is projected from the perpendicular line 1, 2 by the plane of rays 5, *h*, S, paſſing by the angle or perpendicular line 1, 2, and therefore the ſhadow line 5, 1 will vaniſh in *h*, the ſeat of the luminary on the picture; through which a line S S paſſing in a perpendicular direction to the horizon, anſwerable to the perpendicular ſides of the cube, is the vaniſhing line of the plane of rays 5, S, *h*, in the ſame manner, and for the ſame reaſon, as the horizontal *v* V is the vaniſhing line of the ſhadows of lines originally parallel to it. The vaniſhing line S S of the ſun's rays may be ſuppoſed to move along the horizon anſwerable to the ſun's inclination to the right or left of the center of the picture *s*, whether the ſun be ſuppoſed on this or that ſide of the picture, or, as we conceive of it by the figure, whether it be above or below the horizon. Hence, if a plane

of

of rays be ſuppoſed to come from behind the picture, in a direction perpendicular to it, the place of the ſun will be ſomewhere on a perpendicular line drawn through the center of the picture, as S *d*. And this place of the ſun, or, which is the ſame thing, the vaniſhing point S, of its rays, will be above or below the horizon, according to the ſuppoſed altitude of the ſun. If, therefore, we imagine the ſun's altitude to be as before, its place will be at *d* when the ſun is behind the picture, and at S when it is before it; and the vaniſhing point of the ſhadow will be at *s*, the center of the picture. This is evident, for the angle V, *d*, *s*, is the ſame and equal to M, S, *h*. In both caſes the lines *h* S, *o d*, of the angles of the ſun's altitude are the ſame, being equal to the diſtance *s* V of the picture: for, in the ſhadow of the cube, when the plane of rays from behind the picture cut it in the oblique direction of the line *d h*, the line *d h* is then conſidered as the diſtance of the picture, and being turned up to S, is equal to the diſtance of the place of the ſun above the horizon. And ſuppoſe the rays to come to the picture in the direction of *d v*, then *h* would be moved to *v*, and *v d* would be equal to the diſtance of the picture; and being turned up to *v* S, S would then be the place of the ſun, or the vaniſhing point of its rays, and *v* the vaniſhing point both of the ſhadow and ſide of the cube 2, 4. In which caſe we ſhould only have the ſhadow of the ſide 4, 9, 3, 8.

It is further obſervable, that as the ſun may be ſuppoſed to move in a circle, and if that circle be deſcribed by a radius equal to the diſtance of the picture, we may ſhow the different ſhadows of the ſun upon objects at the various times of the day.

Thus:—in Fig. 44, ſuppoſe a line drawn from E W forming the horizon; from the center *s* deſcribe a circle with the diſtance of the picture, and through *s* draw a line perpendicular to the horizon, and M will be the place of the ſun at noon. Now let it be required to find the morning ſhadow of the rod *a* when the ſun has riſen 40 degrees above the horizon, as at 40° S. From 40° S let fall a perpendicular to the horizon at *h*, and draw it through to the other ſemicircle; from *h*, the vaniſhing point of the ſhadow, draw lines paſſing by the bottom of the rod at pleaſure; and from 40° S, the place of the ſun, draw a ray through *a*, the top of the rod, cutting at 1; which ſhews the length of the ſhadow required. Suppoſe the ſhadow of the ſame rod be wanted at noon, *s* will then be the vaniſhing point of the ſhadow, and M the vaniſhing point of the ſun's rays, and the length of the ſhadow will be at 5. Again, if it be required to find the ſhadow of the ſame rod after the ſun has paſſed the meridian 50 degrees, this will bring the ſun to the ſame degree in the afternoon as it was in the morning; and by drawing lines

in

in the ſame manner as in the morning, the ſhadow in the afternoon will be at 2.

Now, if the ſun be conſidered on this ſide the picture, the ſhadows of the ſame rod *a*, at theſe different periods of the day, will be reſpectively beyond the rod at 3, 4, 6, towards the horizon; which is done by tranſprojecting the place of the ſun to S M S, and drawing rays from the top of the rod to each place of the ſun. Thus: from *a* draw the dotted line to S on the left, cutting at 3, and 3 will be the length of the morning ſhadow; and from *a* draw the dotted line to S on the right, cutting at 4, which will be the evening ſhadow. Laſtly, a dotted line from *a* to M, cutting at 6, will be the ſhadow at noon, which is hardly ſeen on the picture. Thus we ſee that the ſhadows of a morning or evening view are long, tending oppoſite ways; and thoſe of a view repreſenting noon-day are ſhort, tending from ſouth to north, nearly ſo. But if we lived in a meridian on the line, then it is evident that at noon there would not be the leaſt ſhadow of objects of equal thickneſs ſtanding perpendicular on the ground: for, ſuppoſe the rod *a* moved into the line M M, then the object would be in the ſame plane with the rays of the ſun; and being directly under it, of courſe all ſhadow would be excluded excepting ſuſpending objects, as No. 2, and thoſe ſupported like tables; in which caſe the rays *r r* falling perpendicular to the

ground, and parallel to each other, on account of the ſun's great diſtance, they would form a cylinder, of which the ſhadow would be a parallel ſection, and therefore muſt be perfectly ſimilar to the object itſelf, both in magnitude and form, as muſt be evident from the figure, and a little reflection on the foregoing principles.

CASE III.

To find the projections of Shadows when the Sun's Rays come on the Front of the Picture.

HAVING already explained the theory of this in what has now been advanced, it remains only to give an example or two to illuſtrate it.

EXAMPLE I. FIG. 45. Plate XXVI.

When the Shadow falls on the Ground.

IN Fig. 45, A is a priſm whoſe ſhadow is projected by the ſun as above propoſed, *h* is the vaniſhing point of the ſhadow, *v* of the ſide of the cube, and S of the rays. Therefore from the angles 1, 2, 3, draw lines to *h*; and from 4, 5, 6, at the top, correſponding with theſe, draw lines to S, cutting at 9, *c*, *b*;

from *b* draw a line to *c*, and from *c* to 9, which, when filled up, will complete the ſhadow.

EXAMPLE II. FIG. 46. Plate XXVI.

When the Shadow falls at the ſame Time on upright, oblique, and horizontal Planes.

THIS figure having the moſt neceſſary lines for repreſenting the two houſes, as well as for finding the ſhadow of one houſe falling upon the other, may be conſidered as an example both of perſpective and of ſhadow. And as the lines for both are here joined together in one view, it will ſhew their relation, and the neceſſary dependence they have on each other; which, it is preſumed, will contribute more to the learner's advantage, than if many examples of ſhadowing had been added without regard to the perſpective lines.

The horizon and ground line being drawn, fix the center of the picture as uſual; from which raiſe a perpendicular as to *d*. Make *d* the diſtance of the picture, and, according to the obliquity ſuitable for the front of the houſe, draw a line to V, for one vaniſhing point; next draw V *d*, and from *d* draw a line to *v*, at right angles with V *d*; becauſe the end and front of the houſe are originally at right angles to each other. Make *v* M equal to *v d*, and whatever angle the pitch of the roof makes,

produce

produce a line from M equal to that angle, continued till it cut a line perpendicular to *v*, as at V; then is V the vaniſhing point for the ſide of the roof of both houſes, and a line from V to V will be the vaniſhing line of the plane which the roof is in, and H will be the vaniſhing point of ſhadows lying in the ſaid plane; and producing V V at pleaſure, and meeting it in *o* at Fig. 44, by a parallel from S, *o* will be the vaniſhing point of the ſun's rays on that plane. Extend the compaſſes from V to *v*, and place it below the horizon, and that point will ſerve for the other ſide of both roofs. The houſes being completed in their outlines, according to theſe vaniſhing points, proceed to ſhade them upon a ſuppoſition that the light comes on in the front of the picture, and in a direction from the left hand parallel to the dotted line *d h*. Therefore the point *h* will be the vaniſhing point of the ſhadows falling upon the ground plane, and producing *h* perpendicular to the vaniſhing line V V, H will be the vaniſhing point as aforeſaid. The place of the ſun S is fixed very low, not as a precedent, but that it might throw the ſhadow of the firſt houſe on the ſecond, affording an occaſion of ſhewing the nature of ſuch ſhadows.

From *g*, the pitch of the roof on the gable-end, draw a line to S; and from *a* draw a line to *h*, which will cut the front of the other houſe at *o*; from *o* raiſe a perpendicular, cutting the line drawn from *g* to *h* in *e*; from *e* direct a line to V, the vaniſhing

niſhing point for the fronts of each houſe, which gives the ſhadow for the roof. From the tops of each chimney draw lines to S, and obſerve that the ſhadow of the firſt chimney falls partly on the roof, becauſe the ray drawn to S cuts the roof, and that ray muſt be cut again, by drawing a line from the top of the perpendicular ſhadow *o e* to H, the vaniſhing point of ſuch ſhadows as fall on the roof, and from the top of the ſhadow on the roof direct a line to *o*, in Fig. 44, which gives the complete ſhadow of the chimney. Laſtly, from *b*, at the bottom of the ſecond houſe, draw a line to *h*; and cut that line by two others, one from the top of the chimney, and another from the pitch of the roof, as before; from theſe interſections draw lines to V, the vaniſhing point of the houſe, and the ſhadows will be finiſhed.

Of Shadows when the Sun is not ſuppoſed to ſhine, or thoſe produced by common Light.

AFTER what has been ſaid on ſhadows produced by the ſun, it will not be requiſite to ſay much on this head. It will, however, admit of a few remarks.

And firſt, ſuppoſe an object *a*, *b*, *c*, Fig. 47, placed to the light, and conſider the parallel lines as rays of common light falling on it; for common light directs its courſe to ob-

jects

jects in this manner. Now it is evident, therefore, that the ſide or plane *a* will have moſt of the light, becauſe the rays fall nearly perpendicular on it, which conſequently excludes all ſhadow; but the plane or ſide *b* receives the ſaid rays obliquely, and in proportion thereto occaſions a ſhadow, becauſe the light partly miſſes the ſurface. The plane *e* is totally in ſhadow, becauſe the ray *r* cannot touch that ſurface.

Secondly, in ſhadows of this kind the contraſt of light and ſhade is not ſo ſtrong as when the ſun's rays fall on objects; the light is not ſo glaring, nor the ſhadows ſo black. The outlines of ſuch ſhadows ought not to be ſtrongly defined, but faint, and ſometimes indiſtinct, eſpecially when the light is ſuppoſed to come from different apertures.

Laſtly, ſuch objects as are ſuppoſed to be viewed in a room have their upper parts lighteſt; but the lighteſt parts will bear a tint, and ſometimes conſiderable, ſo that there will not be much oppoſition of light and ſhade in their different ſurfaces.

It is requiſite to conſider the natural colours of objects, in order to fix the tone and true ſcale of light ſuitable to them *. The lighteſt part of an object that is of itſelf black, would be

* This is alſo neceſſary when the ſun is ſuppoſed to ſhine.

a ſhade

a ſhade to one that is white, and therefore, in producing a ſhadow to any thing black or blue, it will require all the force and ſtrength of the Indian ink. The other colours, as green and yellow, &c. will alſo require a due degree of light and ſhade to diſtinguiſh them by.

Mr. Kirby conſiders the colours receding from white to black in the following order: *i. e.* yellow after white, then green, red, blue, and black, ſucceſſively. It is difficult, however, to diſtinguiſh ſome of theſe by the effect of Indian ink, yet it is evident ſomething may be done towards it. Thus: the cube W is ſuppoſed to be white, Y yellow, G green, R red, B blue, and BL black *.

Of the Proportion of Tints ſuited to Objects at different Diſtances in the ſame Picture. See a View, Plate XXVI.

It is evident, from the nature of perſpective in general, that not only the proper dimenſions of objects, but alſo the degree of tint, is eſſential in making them appear at different diſ-

* This is not the order of the ſimple colours, according to Sir Iſaac Newton's theory of their origin. His theory informs us, that when the rays of light are ſeparated by the refraction of a priſm, the firſt will be red, then orange, yellow, green, blue, indico, and violet, ſucceſſively. See his Optics, Book I. Prop. 6. According to this, white is not a ſimple colour, but a compound or mixture of all that are ſimple, and black a total privation of every colour.

tances. For, as in linear perſpective, objects are viewed under a ſmaller angle in proportion as they are at a diſtance, ſo in the aerial part every tint and ſhadow gradually weakens as the object is ſituated at a diſtance from the front of the picture. The reaſon of this is obvious, when it is admitted that we are made to ſee objects by innumerable beams of light iſſuing from them to the eye. It is eaſy then to conceive, that when theſe beams or rays of light have to make their way through the air from diſtant parts of the horizon to the eye, they muſt greatly weaken before their arrival to it, and therefore ſuch diſtant objects muſt appear leſs diſtinct and more dim in proportion to that diſtance. Hence, in a picture, as in the view given in Plate XXVI. objects on the fore ground are not only larger, but they are more made out, more diſtinct, and ſtrongly marked. Their lights are brighter, and their ſhades are darker, than thoſe on the back ground. This will, perhaps, be more eaſily underſtood by the following obſervations on the view.

The tree on the left is neareſt to the eye of the ſpectator, and is therefore moſt made out; its leaves are ſeen in cluſters, and its ſhade is ſtrong.

The firſt tree on the right, being further back, is leſs diſtinct in its parts, and rather fainter in its ſhadows; and ſo of the reſt in proportion to their diſtance.

With

With reſpect to the houſes, we ſee the ſecond weaker in its parts, and its ſhadow, partly on the water and on the ground, fainter than that of the firſt. The laſt houſe being at a vaſt diſtance, appears as one maſs without diſtinction of parts; and thus objects diminiſh off till they and the horizon on which they ſtand mix with the ſky.

Of the reflected Images of Objects on Water.

To aſcertain the reflected images of objects on water is exceeding eaſy, and very eſſential to ſome pictures. It is a law in catoptrics*, that the angle of reflection is always equal to the angle of incidence †.

The angle of incidence and reflection may be thus underſtood and diſtinguiſhed. The inclined poſt, and its ſhadow on the water, form an angle with each other; and at the bottom of the poſt, where the line of reflection on the water and the line

* Catoptrics, from κατοπτρον, *katoptron*, a mirror or looking-glaſs. Catoptrics teach the ſcience of reflex viſion, and optics that of direct viſion, though in the general and extenſive meaning of the term optics, "from οπτομαι, *optomai*, I ſee," it includes in it "whatever relates to ſight, or the doctrine of viſion;" and therefore muſt imply dioptrics alſo, which teaches the properties of refracted viſion; that is, when rays of light paſs through one medium into another, as air and water.

† See ſecond axiom of Sir Iſaac Newton's Optics.

of incident rays from the poſt meet, that point is termed the point of incidence; and if from the top of the poſt a perpendicular be let fall, it will form a triangle; and if that triangle be biſected; that is, by drawing a parallel line from the point of incidence *b*, cutting the perpendicular at *c*, then the angle *c*, *a*, *b*, is the angle of incidence, and *c*, *d*, *b*, the angle of reflection, which are equal. Therefore if an object be perpendicular to the horizon, its reflected image on water will alſo be perpendicular, but in an inverted poſition to the object which reflects the image. And whatever angle of obliquity any object makes with the ground, the ſame will be its reflection to the ſurface of the water.

The reflections of images on water are the ſame as thoſe in a plain mirror. The ſurface of the mirror or looking-glaſs is the plane of reflection; and it is evident, that in whatever poſition any object is preſented to it, the ſame will be that of its reflection on the ſaid plane. If a rod, &c. be placed perpendicular to the mirror, its reflected image will be perpendicular to it alſo. And if one end of it touch the glaſs, its image will alſo appear to touch the ſurface of it; or if it is withdrawn, its image will appear equally removed from the reflecting plane. This experiment is within the reach of every one, and will be ſufficient to convince any of the truth of the above propoſition.

EXAMPLE

EXAMPLE I. See the View, Plate XXVI.

IF, therefore, the reflection of the inclined poſt be wanted, let fall a perpendicular at pleaſure, and cut that perpendicular by a line drawn from the bottom of the poſt inclining to the ſaid perpendicular in an angle equal to the object, and it will give the length and inclination of the reflected image. And obſerve, that the length of the reflection on the water will be in proportion to the diſtance of the object from it; conſequently if the poſt were removed a little further from the edge of the water, we ſhould loſe its reflection entirely.

EXAMPLE II.

IF it be required to find the reflection of any of the trees ſuppoſed to ſtand nearly perperdicular, let fall a perpendicular from the bottom of it, and take the whole height of the tree and place it downwards from the bottom of it, then take the length of the trunk and do likewiſe, which will give the reflection as required.

Laſtly,

Laſtly, it is manifeſt from theſe principles, that if any object be floating in the water, ſuch as a piece of timber or a ſhip, that its reflected image will be equal in length to the object itſelf, and the depth of the reflection below the ſurface of the water will be equal to the height of the object above it.

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Fig. 41.

How to put a Cylinder Desk and Bookcase in perspective being oblique to the picture

See expl in p. 321.

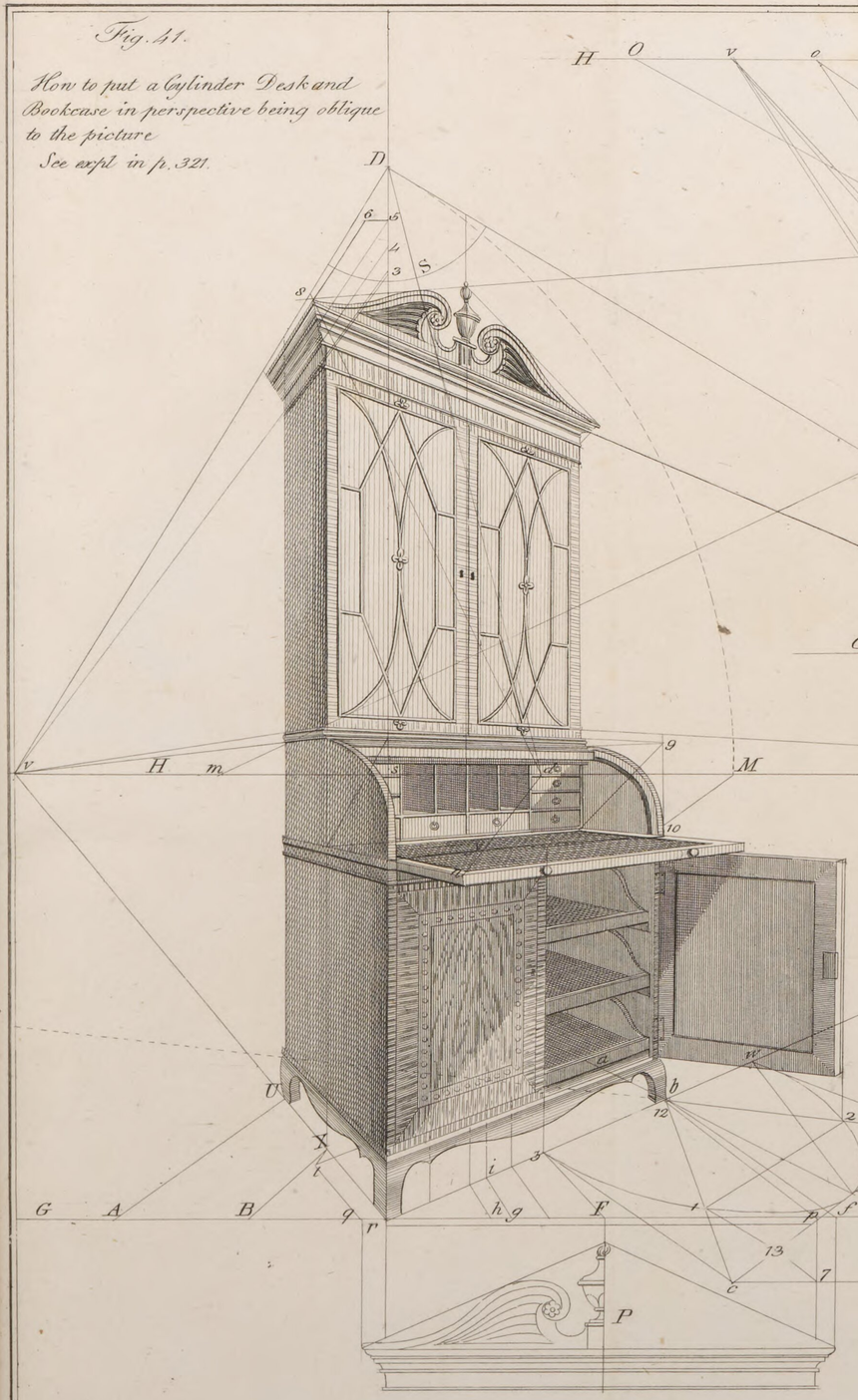
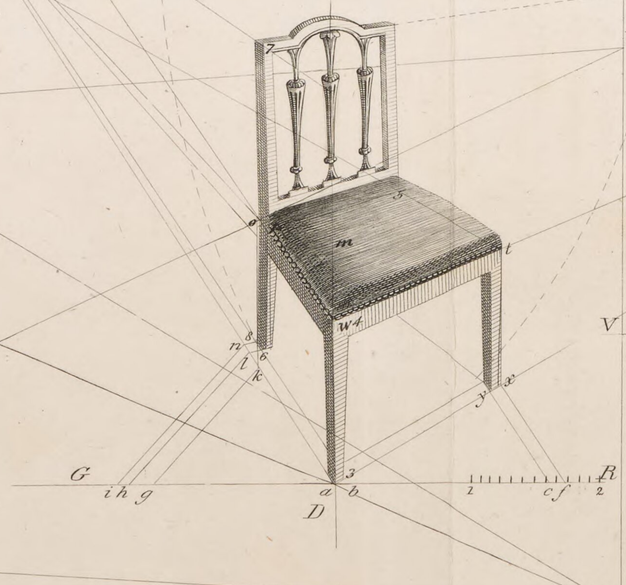
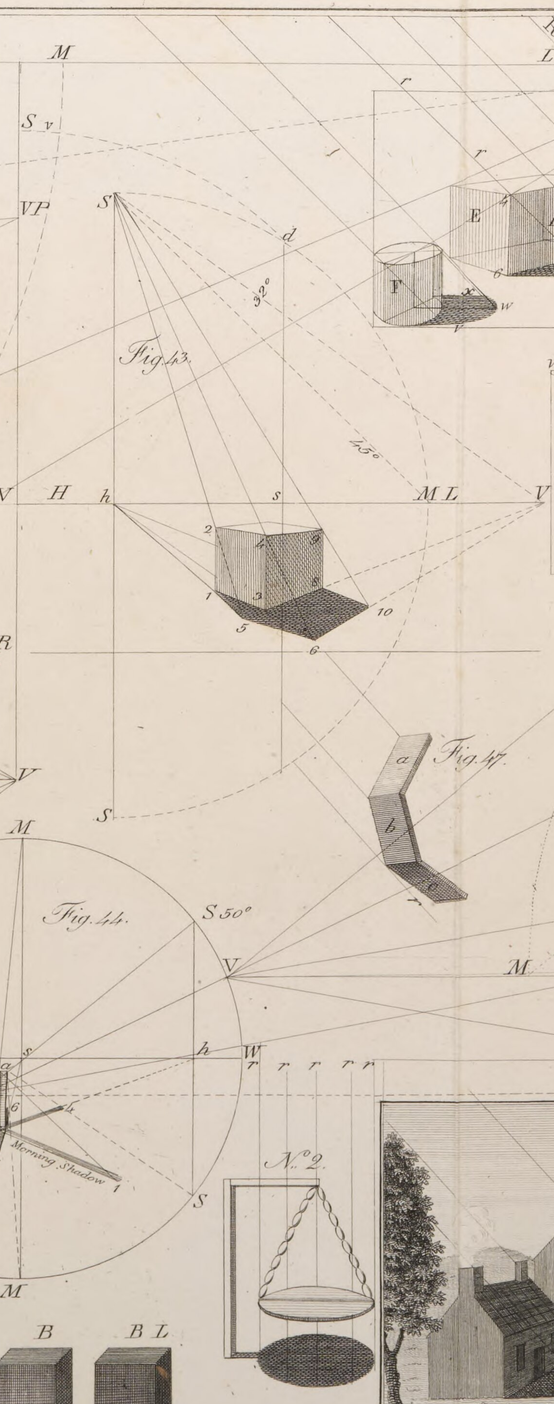


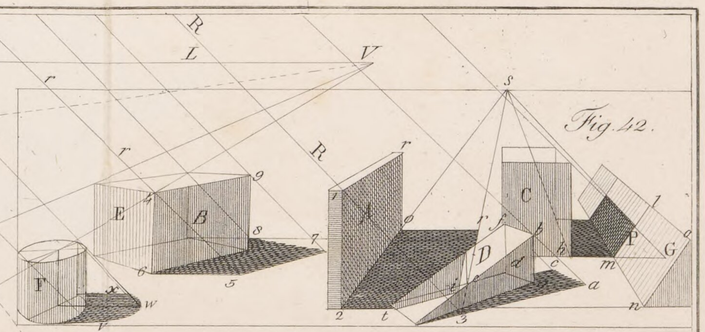
Fig. 40.

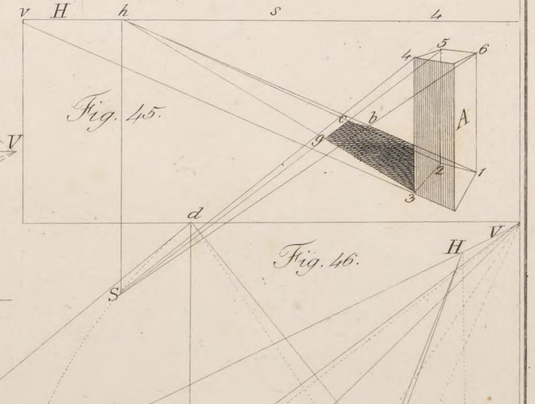
An oblique view of a chair

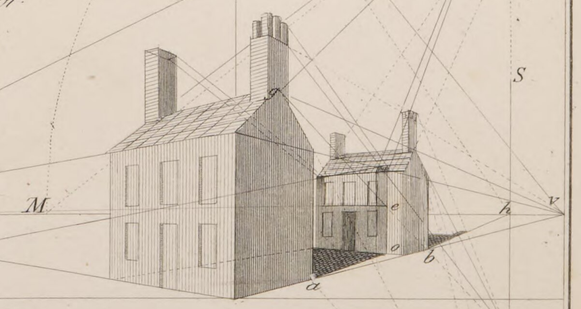
See p. 319.













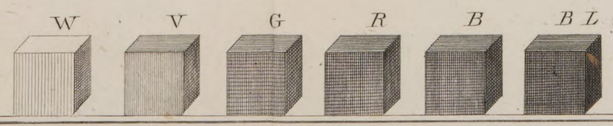


Fig. 46.

T. Sheraton. del.

Published as the Act directs by T. Sheraton Novr. 20th. 1792.

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The Cabinet-Maker And Upholsterer's Drawing-Book In Three Parts

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